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August 24, 1922

Engineering News-Record

How Rails Were Inspected in the Grand Trunk Arbitration
By J. P. Newell

Telescoping Towers Used to Carry Arch Centers for New Concrete Bridge

Effective Methods in the Making and Using of City Maps
By S. M. Cotten

From Job and Office:
Hints to Contractors and Engineers that Cut Cost and Time

Floating a 66-ft. span center about a half mile down the Susquehanna

General Motors Trucks

One of the Fleet of GMC Trucks operated by St. Louis County, Minnesota, in good road construction.

GMC Trucks Travel Hills and New Roads Where Other Trucks Will Not Get Through

Recently the road commissioner of St. Louis County, Minnesota, added two 2-ton GMC dump trucks to his fleet of 15 other GMC trucks of various capacities.

These were the new K Series GMC trucks with the now famous two-range transmission, which develops more power at the wheels and more speed on the road in the same truck than heretofore has ever been accomplished. These trucks, now in active service, travel places where other trucks cannot go. They have been assigned to the hilliest district of the country to haul materials for new roads.

In addition to these trucks the county now owns nine other GMC trucks that it has purchased outright and six other GMC's that were turned over to them by the government after the close of the war. All of the trucks are giving excellent service.

Well Suited For Fleet Users

Not only because of the low operation and maintenance of GMC trucks and their unfailing service for a long period, but also because they are standard built, these trucks are being adopted everywhere by concerns which use large truck fleets.

For there is practically no difference between the construction of the various models of the GMC line except as to size and strength of units. This standardization of manufacture is reflected in actual service by the savings that can be affected through having drivers, garagemen and mechanicians working only upon one style of truck.

Moreover the GMC line ranging from one to five tons capacity, offers every practical size for any business. Firms needing both heavy duty and light speedy trucks find the GMC line fits their business requirements perfectly since they have a truck which is exactly like the others in their fleet.

Real Motor Truck Construction

GMC trucks are real motor trucks. There is not a passenger car part in them. Every unit is built for truck use only. Moreover these trucks have been designed for truck use as well as built for it. The engine in GMC trucks was developed for these trucks only. It is not a large sized passenger engine but a real truck power plant embodying features that meet the wants of truck users and that have been determined from a decade of successful truck building. The same thing is true of transmissions, axles, wheels and all other parts of the chassis. Even the electrical equipment is built particularly for GMC trucks and the battery supplied for the lighting system is of extra size and capacity.

GMC trucks all have magneto ignition, electric lights and generator, pressure gun lubrication of the chassis, radius rods, interchangeable brake rods and a host of other refinements that are particularly fitted for motor truck usage and that go to create the dependability for which these quality trucks are known everywhere.

And the cost of GMC trucks is remarkably low considering their quality. The chassis lists at the factory as follows: one ton, $1295; two ton, $2375; three and one-half ton, $3600; five ton, $3950; tax to be added.

GENERAL MOTORS TRUCK COMPANY

Division of General Motors Corporation

PONTIAC, MICHIGAN

Dealers and Service in Most Communities

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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The Mis-Step

It is easy, if one agrees with our comment on the President's cures for transportation strikes, to explain why the shopmen's dispute has dragged on so long. The President has condemned his own action. He declares that the Railroad Labor Board's decisions must be made enforceable. Yet he failed to put his great moral influence back of the board when the strike began. He actually proposed a settlement that went contrary to the board's views on seniority. Once he weakened his influence was gone. Both sides have rejected his overtures. His course should have been to support the board solidly. He could have aroused the country as it was at the threatened tie-up last year. The strike would have faded. The seniority issue—the present barrier to peace—would not have been resurrected.

Truth, the Tortoise

TRUTH, we are often told, is stranger than fiction. Unfortunately, this aphorism, like so many of its kind, is subject to many reservations. Some truth, we may say, is stranger than some fiction; but as a rule drab fact must yield to the more stimulating product of imagination. This observation is prompted by Mr. Ridgway's review in this issue of the recent accidents in the New York subways. Many of our readers in New York and elsewhere have learned through the daily press of happenings that seemed to be of most serious import and consequence, but relatively few have seen the later accounts announcing the facts as disclosed by investigation. The facts received nowhere near the prominence accorded to the earlier sensational and imaginative accounts. Truth was neither so strange nor so startling as fiction and suffered the consequences. And in addition to being commonplace, truth often labors under the handicap of arriving so late that everyone has lost interest in its subject.

Wise City Mapping

MAKING city maps for either special or general uses often requires actual field work, despite the fact that the necessary data have been previously secured, though for other purposes. Uncertainty as to exact boundary courses, monument positions or important topographic features may require a trip to the field for every new map prepared, unless definite record and use are made of all survey data acquired. Then, in changes in city engineering personnel important records may be mislaid or lost, and the loss of one may mean extensive resurveying. Again, an engineer stepping into a municipal position is often apt to view the work of his predecessor as more or less unreliable unless he have convincing proof to the contrary. Resurveys should be unnecessary except under unusual conditions. Needless duplication of effort in map production indicates weakness in office administration. Such processes are costly, and they abet an inclination to question the general surveying accuracy. How to adapt original information to any desired use, whether general or special, and how to produce maps with the least duplication in drafting detail is told on page 312 of this issue. Mr. Cotten describes a procedure that is well worth following.

Another Activated-Sludge Advance

CONFIDENCE in the activated-sludge process of sewage treatment, already strong in many quarters, will be materially increased by the report of Messrs. Eddy, Fuller, and Hatton recommending a plant of that type for the North Side of the Sanitary District of Chicago, and by the adoption of the recommendations by the district trustees (see p. 324). Works of the same type are already being constructed at Chicago, but they are relatively small. The estimates for the North Side plant are based on a *maximum* daily flow of 263 m.g.d. in 1930. The Milwaukee plant—many times the largest of any activated-sludge works yet put under construction, or even projected before the Chicago North Side works—is based on a maximum flow of 165.5 m.g.d. in 1930 and 231 m.g.d. in 1950. The population of Milwaukee in 1920 was 457,000. We have, then, one activated-sludge plant well under way to serve more than a half million people and another one, to serve well towards a million population. Besides these, activated-sludge works for Indianapolis (1920 population, 314,194) are well on towards completion. The 10- and 5-m.g.d. plants of Houston have been in operation for several years, as have a few other and smaller ones in the United States, Canada and England. If there are sceptics as to the activated-sludge process being worthy of consideration with other methods wherever a considerable degree of sewage treatment is required, their doubts should be removed by the Chicago report and its adoption and by the other facts just outlined.

Sludge Dewatering in Abeyance

ALTHOUGH the experts called in by the Chicago Sanitary District did not hesitate to recommend the activated-sludge process they did not feel that the time had come to install a sludge-dewatering plant for the recovery of the fertilizing value. As to this, it should be noted, first of all, that there are local reasons for postponement of sludge-dewatering on so large a scale at Chicago. The Sanitary District expects to test dewatering at one or both of the two activated-sludge works it now has under construction. Moreover, the sludge from the larger North Side works is to be forced to lagoons on land owned by the district, suitably located to serve as a site for a central dewatering plant for several works. It should also be noted that the experts'

report was made last February and adopted by the district trustees in May, before the conclusions of the more recent of the sludge dewatering tests at Houston, Tex., were announced (see *Engineering News-Record*, July 27, 1922, p. 132). When details of the later Houston dewatering results are available, and can be considered in the light of working results from the plants now being built for Milwaukee, Indianapolis and Chicago, we may at least hope that the dewatering of sludge from activated-sludge plants will have been placed on a stable basis, both mechanically and financially. By then the fertilizer market may be on a more certain basis, both for sewage sludge and garbage tankage, than it has been of late.

Sewage Treatment Extending

BROADER aspects of the adoption at Chicago of a sewage-works scheme for the North Side deserve notice. The Chicago Sanitary District is now well committed to a change from sewage disposal by diversion and dilution. This means sewage treatment to a relatively high degree for some three million people, whereas heretofore Baltimore, with its population of 734,000 in 1920, has been the sole example of a large American city that was treating its sewage. With Baltimore, Milwaukee, Indianapolis, and now the Chicago Sanitary District, which embraces the second city of the country, treating or committed to the treatment of their sewage, other large cities may be expected to follow, each with its own interesting and often complex problem for the solution of engineers, chemists and biologists, and with the resulting train of work for manufacturers and contractors; and after that a demand for trained operators and operating advisors that will increase both in the number and skill required. This outlook is encouraging for all concerned, including the cities themselves and the progress of river cleansing and water sanitation.

Is it Merely Summer Madness?

A FAVORITE topic in "polite" circles since the war has been the "panning" of the workingman for getting as much as possible for a minimum of work. Everybody has some evidence, the manufacturer, the contractor, the office manager. Even the housewife is qualified to testify: Hilda, who got $30 per month in 1914 for doing "everything, including washing," gets $65 now for the cooking alone. If perchance she gets $75 she has to have a helper to shortcut the potatoes to the garbage pail and de-sand the spinach. "The higher the wage, the fewer the work"—to paraphrase the old by-word.

We confess that we joined the chorus. We went farther. We wrote editorials about it. We preached the gospel of work.

We were right. We stand by what we said. Only we now wonder whether we saw only the mote in our brother's eye.

And did the manufacturer and the contractor, the office manager and the housewife likewise miss the beam in their own.

We've thought a lot about it this summer, just because we had to print a paper, which means doing business with other men. That has been a hard job. "Mr. Dobbins is away for the month." "Mr. Robbins does not come in Saturdays." "Mr. Bobbins leaves Friday noon for his rock farm in Connecticut, returning Monday at 12."

We were too polite to ask whether the salaries were still going on.

Nor was Dobbins or Robbins or Bobbins carrying the big burden of the business. He was pretty well down the ladder.

And we wondered how the rest of the organization was working, and whether Dobbins *et al* were in some of the "panning" parties we had attended.

We've felt pretty badly about it. We've written, mentally, homilies about the "uphill climb being the only one that develops real character and stamina." We've read de Tocqueville's counsel that the older a man grows the more work he needs to do to prevent him falling behind. We've pondered how Carnegie and Rockefeller, Edison and Westinghouse, Lincoln and Roosevelt performed their prodigious tasks. We've recalled how successful businesses have been built.

And then has come the thought, Is it merely summer madness? Will it pass when September crisps the air? Will hard work—giving all one can because of one's enthusiasm for the job—reassert itself?

Possibly and possibly not. Our own feeling is that all too many men are flattered by a little success and, proceeding to swell up and to regard themselves as "big" men, believe they can rest on their oars. Sometimes there is a fatal element of "four-flush" in it.

Certainly the man or the business that thinks the hard-work days are over has dropped behind. A man who has a copper-riveted competence may be able to ease up. A business, never.

The President and the Railroad Strike

THE PRESIDENT'S views on the remedy for the ills that now beset the public by reason of the railroad strike fall into two categories—that the decisions of the Railroad Labor Board must be made enforceable and that there must be no interference with men who desire to continue at work. The last was given a special emphasis that has been much commended. Unfortunately there was nothing in the President's address to Congress that pointed to immediate remedy. He explicitly said that he would not ask action on his first suggestion, while by his own confession the moral influence of the federal government has availed little in the present strike to prevent violence and intimidation. Indeed there are difficulties in the way of both of his solutions.

It will be readily agreed that the Railroad Labor Board should have the power to enforce its decisions. A service so vitally affecting public welfare may properly be hedged about with the condition that all who enter it undertake to forego the right to strike. Whether Congress will lay down this condition and set a penalty for violation, whether it will take even the smaller step of holding the union leaders responsible for organized stoppage of work remains to be seen. It refused to accept such provisions when the Transportation Act was passed. Has the present strike changed its views; which is another way of asking whether union influence has waned with Congress.

But even if such provisions are written into the law, will they be effective? Compulsory arbitration has failed in Canada and Australia. Will it succeed here? It will only if the true seriousness of the offense is put

strongly before the public or if the public's toes are stepped on. Only then will the public exert its pressure. Of instant disapproval we had an excellent example when the train-crew brotherhoods threatened to strike last year. The public's protest was menacing—and the strike was canceled before it started. But when, as in the present instance, the public does not suffer, it will not exert pressure unless some one arouses it by a strong statement of the facts, the losses and the consequences. That "some one," in the case of a railroad strike, must be the President of the United States.

A Roosevelt would get action.

As to his other cure, protection from violence and intimidation of men who want to work, strong executive support is equally needed. Even then this protection may not be afforded. Local opinion determines the enforcement of law. Herrin today is a disgrace to America. The law is flouted because the law officers and the community are on the side of the law breakers. Yet the effort must be made. Some one must thunder and put the public back of the law.

Again the President is that "some one" when the strike is national and affects interstate commerce. The effective officers may be the governors of states, but the President can dramatically put the public behind them.

From mere legislation then we are not sanguine of results. From legislation backed by the Rooseveltian passion for the maintenance of the law there will be effective action.

The Heart of the Problem

THE BITUMINOUS coal industry has declared a truce to run until April, 1923. By it, the United Mine Workers have won their demand for a continuation of war-time wages and the public is already reaching into its jeans to pay the bill. Negotiations now under way give promise of a similar result in the anthracite field, and by the time this is printed an agreement may have been reached.

Meanwhile, President Harding has submitted to Congress two definite requests. One is for authority to create a commission to investigate the coal industry and "to reveal every phase of coal production, sales and distribution." This he intends as a first step toward finding a cure for the economic ills of the industry. His second request is for a temporary national coal agency with power to use public funds for the purchase, sale, and distribution of coal in interstate commerce. This is frankly an emergency measure designed to curb exploitation of the public through the impending coal shortage.

The more far reaching and, in the long run, more important of these recommendations is that which proposes the commission of investigation. As a rule we are not enthusiastic over governmental commissions but in this case there seems to be no other way out. The President is right in his insistence that such a commission shall be non-partisan rather than bi-partisan, as is so persistently argued by some in the industry. It is almost time that both miners and operators were made to realize that theirs is not a "private fight." The President should see to it, moreover, that the personnel of the commission does not consist of actual or would-be politicians, office holders, legislators, or other members of the axe-grinding, vote-serving fraternity.

Real work lies ahead of such a commission, for the coal industry appears to be in an astonishing mess. For five months we have been deluged with "facts" at the hands of both miners and operators. From these "facts" anything might be proved, depending on who did the proving. The prime need is an impartial and thoroughgoing investigation, conducted to ascertain facts that are four-square and that will bear the light of day from whatever direction it may shine. But beyond this fact-finding function the most important work of such a commission will be the formulation of the "constructive recommendation" the President declares to be so imperative. The tenor of such a recommendation we scarcely can anticipate. But the nature of the problem is not far to seek, and the questions that will loom before the commission have already begun to shape themselves in the minds of thinking people. Without generalizing too broadly, we might almost boil most of these questions down to one, "Why is not the coal industry as other industries are?"

The basic difficulties appear to arise from interference with the operation of economic laws. Here is an industry with a productive capacity of nearly 800,000,000 units annually and a maximum recorded annual demand of less than 600,000,000 units. Some of its 10,000 producing elements are efficient, others are not. In any ordinary industry under the influence of a restricted demand, the normal operation of economic law will strike down the inefficient. But in the coal industry, this does not come to pass. An explanation might be found in monopoly or far-reaching combination, but as a matter of fact, the market seems to be wide open and competitive. What is the reason for this?

This industry, furthermore, is overmanned in proportion to its over-capacity and as a result, there is not steady work for all its workers. In other industries under these conditions, forces are reduced and workers seek employment in other fields. But in the coal business, all are kept at work, even though most of them can put in so little time that high unit wages produce but small income; and the coal-buying public is forced through a needlessly high price for coal to contribute to the support of idleness. And this idleness is not the idleness of seasonal production, for contrary to popular belief, the output is remarkably constant. What, again, is the reason for this?

These are the fundamental questions that will confront the investigating commission. Somewhere in the coal industry there is a departure from the process of what we usually regard as economic law. This divergence may be a natural and inevitable result of circumstances peculiar to the industry; if so, the matter has not yet been explained. On the other hand it may be due to a wholly artificial and possibly predatory interference with normal processes. Whatever the cause, it is certain that any violation of economic law entails a loss to someone; and when the violation affects the supply of necessities, producers are almost invariably enabled to shift the loss to the consumer.

Before there can be peace and progress in the coal industry, the source of this difficulty must be run down and corrected. If the trouble be due to artificial interference with economic law the remedy must be sought in the re-establishment of normal conditions and not in the imposition of further artificial regulation. We cannot find a cure in the hair of the dog that has bitten us. This is the task before the commission for which the President has asked.

Telescoping Tower on Scow Shifts Arch Centers

Ten Steel Centers Used for Spans of New Harrisburg Bridge Across Susquehanna—Set Up Twice Under Each of 46 Arches —Scow Trips of 3,000 Ft. With 60-Ton Centers Assembled

ASSEMBLED steel centers for 66-ft. arches will be set up and taken down some ninety times by means of a floating erector employed at the Susquehanna River bridge of the Philadelphia & Reading R.R., at Harrisburg, Pa. This erector consists of a steel-frame tower

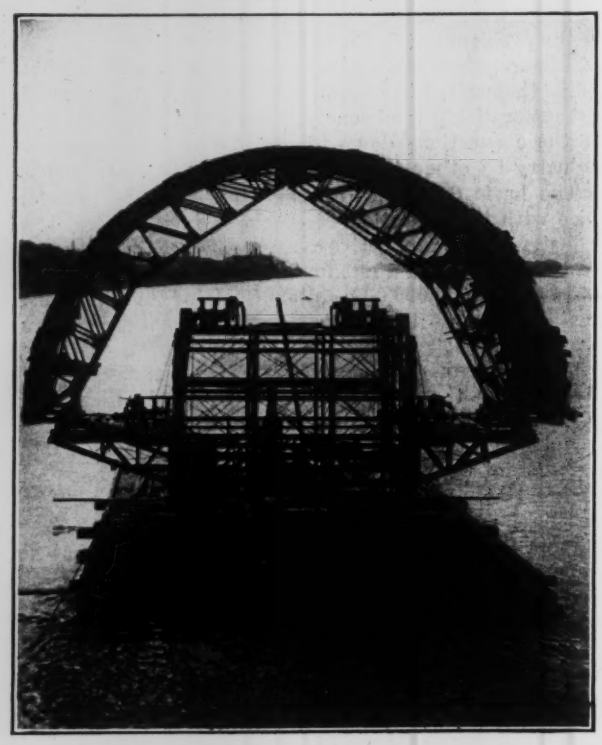


FIG. 1. CENTER ON ERECTOR MOVING TO NEW POSITION

mounted on a scow, and made of three parts which slide up and down on each other, or "telescope," so as to alter the height of the tower. A variation, between bridge ends of 24 ft. in the height of the spring lines above water level, made an alteration in the height of the center necessary for each arch. The telescoping feature of the tower provides for this adjustment of the center vertically, while the floating support is a most flexible means of conveyance from span to span and from side to side of the bridge.

There are 46 spans in the new bridge only two of which are wholly on shore. Under all the others, with perhaps a little crowding at the banks, scows can be floated. The clear spans are all 66 ft., but the two shore spans are 70 ft. 6 in., center to center of piers and the others are 73 ft. 3 in. The arches are circular with a 3-ft. ring at the crown. Between parapet walls the width is 31 ft. 6 in. and it provides for double tracks. One-half of the width comes directly in the place occupied by the present steel bridge so that the new bridge is being built a half at a time except the piers. These were built full size encasing and extending with concrete the old steel bridge piers and building additional intervening piers of concrete. The arches were built first for the half of the bridge not interfering with the old steel bridge. When the tracks are shifted to this half from the old bridge that structure will be removed and the remaining half of the concrete arch structure will be completed.

Half of the bridge being built at a time, the center for each arch has to be erected and taken down twice. With water under all but two spans and high water, drift, ice and navigation obstacles to fixed falsework, the natural thought was to plan a few centers which could be used repeatedly and to employ water craft as the means of shifting the centers. The hard usage of repeated shifts made steel the obvious material for the centers. For the same reason it was apparent that the arrangement for placing, removing and transferring the steel ribs ought to be of the erector type—a mechanism which would lift down the assembled structure, safely carry it to another place and put it up again, performing, incidentally, all the necessary adjustments. In these circumstances centers and erector were parts of a single problem in design and fabrication and were arranged to be handled together by the Blaw-Knox Co., Pittsburgh, Pa.

Each center consists of three steel-arch ribs with hinges at the crown. The ribs are assembled, completely braced and lagged, as a unit. In place they rest on brackets set into niches molded into the concrete piers. The view, Fig. 2, shows a series of centers in place, with the old steel bridge visible through them. When being erected, lowered and shifted they rest on

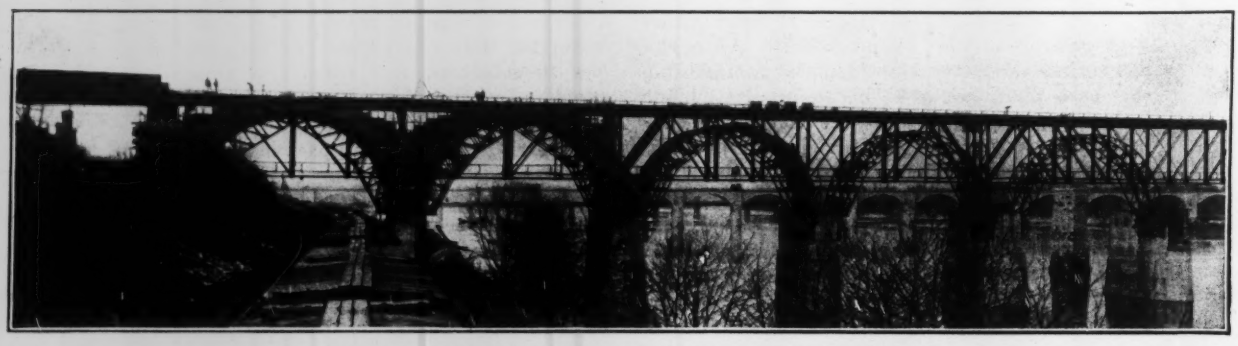


FIG. 2. CENTERS IN POSITION ON HARRISBURG BRIDGE

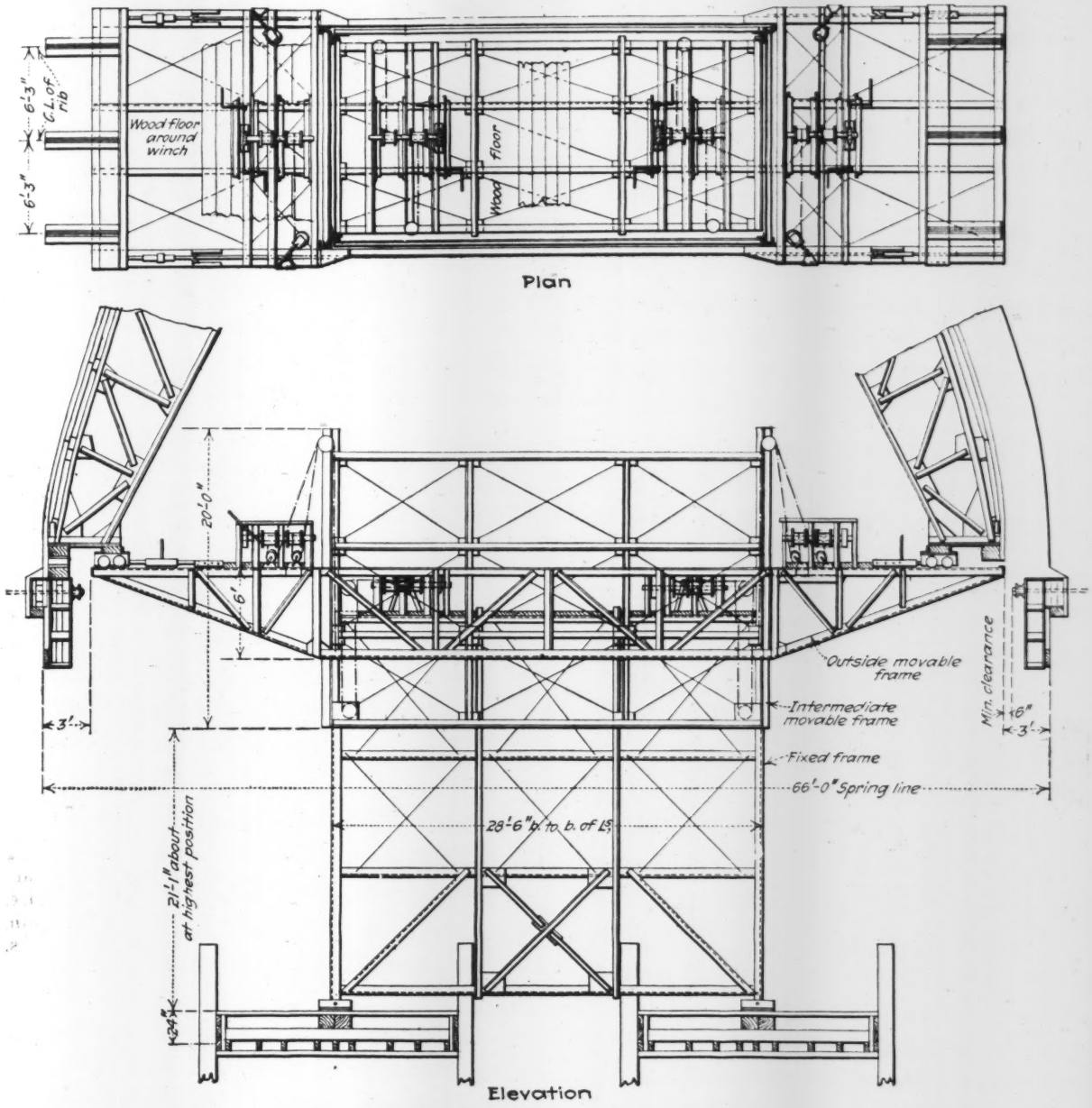


FIG. 3. DIAGRAM OF ERECTOR FOR MOVING CENTERS

the cantilever arms of the erector as shown by Figs. 1 and 3. Once assembled a center does not need to be dismantled and none of them were while one-half of the bridge was being built. In the considerable intervals between the building the first and second half, it was necessary to dismantle and store the centers.

The distinctive feature is the erecting tower. This is shown in general detail by Figs. 1 and 2. It consists of (1) a rectangular steel frame fixed on the scow; (2) an intermediate movable frame which slides up and down on the fixed frame, and (3) an outside movable frame, with cantilever arms, which slides on the intermediate frame. The movable frames are operated by winch drums operated by a worm drive so that the movements are always under control. Fig. 3 shows the position of the centers on the erector, on the left side when the center is in position for concreting and on the right side when it has been contracted for moving. For transfer from arch to arch the movable frames are lowered so as to bring down the center of gravity and make the load safe for towing. Fig. 1 shows the center in towing position.

A change of center from arch to arch requires about one day, including all adjustments and getting ready to concrete. To raise the center from its lowered position while being towed, takes about 2½ hours. Experience with the erector has demonstrated that for the work it has to do the structure has to be strong and rigid and there must be ample reserve power in the hoists to make operation easy and sure.

The contractors for the bridge are the James McGraw Co., Philadelphia, Pa. It was designed by the engineers of the Philadelphia & Reading Ry., Samuel T. Wagner, chief engineer.

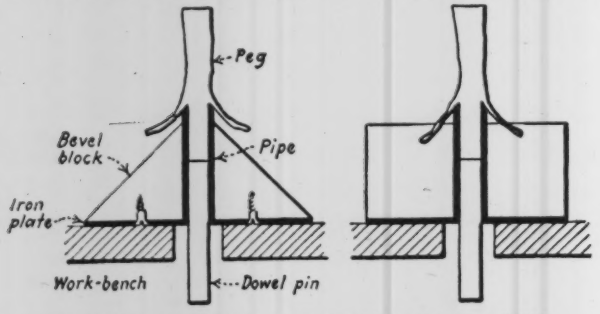
FROM JOB AND OFFICE

Hints That Cut Costs and Time *For Contractor and Average Engineer*

Dowel Pins Made from Pick and Shovel Handles with Improvised Device

ACCORDING to a recent issue of *Engineering and Mining Journal-Press*, a supply of dowel pins was needed to dowel wooden air pipe at a certain isolated mine. To send out for the pins would have involved a delay of two weeks, so the pins were made from pick and shovel handles with a device improvised for the purpose.

The device consisted of a 3-in. length of pipe with an internal diameter equal to that desired for the



IMPROVISED DEVICE FOR MAKING DOWEL PINS

dowels. This pipe was filed square on one end and beveled toward the inside on the other end. The pipe was set vertically with the beveled end upon an iron plate over a hole of the same diameter as the pipe. It was held in position by a beveled wooden block, which was screwed to the iron plate in the fashion shown in the accompanying illustration.

Old pick and shovel handles were sawed into 4-in. lengths and then split roughly into square pegs. The pegs were then driven through the pipe with a wooden mallet. The dowel pins were thus made rapidly and at a small cost.

Plan and Photograph of House on Same Print

In *Engineering News-Record*, May 25, p. 886, there appeared an article entitled "Plan and Photograph of House Shown on Same Print." This journal has received a letter from G. H. KcKelvey, Westfield, N. J., in which another method of doing substantially the same thing is described. Part of the letter follows:

If the plan of the house had already been drawn on paper or tracing cloth to a scale different than that desired on the finished print, the quickest and cheapest method would be to photograph it on a portion of the same negative which was to be used for the picture of the house, or on a separate one. This plan photograph could be reduced or enlarged, as desired, and there would be no necessity for redrawing or retracing it. Personally, I would prefer to make a photograph of the house, get a print of it or enlarge it to the proper size and then mount plan and photograph together on white paper. Then a photographic copy giving both could be made, with the same density of film for both parts. This would obviate any difficulty in unequal development of plan and photograph. If the plan of the house had to be drawn especially, separate negatives could be made and the development of the prints simplified.

Replacing Roller Bearings and Bed Plates Under Bridge Spans

BY A. A. BLAESER
General Contractor, Allentown, Pa.

IN REPLACING the bed plates and roller bearings under the expansion ends of several spans of the Pine Street Bridge across the Lehigh River at Catasauqua, Pa., use was made of a device, which, besides presenting several structural advantages, allowed all the work to be done from the tops of the piers. The bridge trusses were 19 ft. on centers and the span lengths were 147 ft. for the seven-panel and 168 ft. for the eight-panel trusses. The roadway was laid with a wood-block pavement on 3-in. creosoted planks resting on I-beams running to girders at the panel points. The bridge was provided with 6-ft. cantilevered sidewalks of 2-in. creosoted planks.

The device used consisted of a saddle placed under the batter post of the truss and hung on U-bolts from a 4-in. pin that was run through the center of the web of a 15-in. H-beam used to stiffen the batter post. Two flat straps engaged this pin at their lower ends and another pin at their upper ends. This second pin was cradled in a U-strap and took bearing on steel

FIG. 2. TRUSS JACKED AND ROLLERS REMOVED

plates placed on short 15-in. I-beams set perpendicular to the truss axis and high enough to clear the batter post. Under the ends of these short beams were placed the jacks.

The plates under the second pin had the effect of distributing the load over the top flange of the short beams, lessening the possibility of buckling the web when the truss had been jacked. The centers of the plates were cut out and slipped over the U-straps before the pin was placed, preventing the I-beams from spreading. The beams were tied together by light angles fastened with long bolts.

In raising the first span one 35-ton ratchet jack was used under each truss. The off side was blocked about 4 in. before jacking operations began. When the

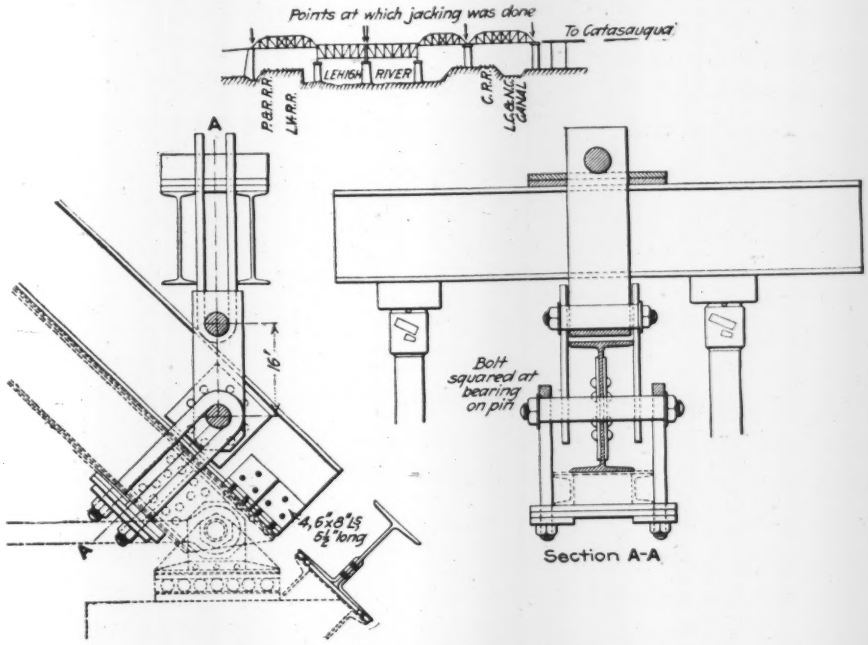


FIG. 1. DETAILS OF TRUSS JACKING RIG

sufficient lift had been attained the jack was then about 4 in. higher. After this first span had been jacked, however, it was found more practicable to use two jacks under each truss, a method that was followed in remaining operations. The 15-in. H-beam which reinforced the batter posts was held at its upper end near the top of the batter post by a heavy clamp and at its lower end by removing eight rivets and replacing them with bolts.

By means of this device we were able to work entirely from the top of the pier by cutting out a 3-ft. x 3-ft. square in the flooring. This was a decided advantage inasmuch as the top of the pier was more than 30 ft. above the track and canal bank level. The double-pivot arrangement allowed uneven jacking and allowed for expansion or contraction. When the truss was jacked up the necessary distance (about 1½ in.) the old rollers and bed plates were removed and blocks were inserted under the shoes so that all unnecessary risk would be avoided. After the rust had been scraped from the shoes the blocks were removed, the bed plates and rollers set in and the bridge lowered.

We also lifted the ends of two half-deck spans which came together on the river pier. This operation was comparatively simple. The latticing was removed at one point and holes were drilled into the flanges of the vertical end-post channels. Heavy plate was then bolted onto either side of the post, the base of the plate being cut to fit over a 4-in. pin placed in the pocket and acting as a beam to carry the load to the 15-in. H-beam placed on either side of the post and extending over the pier. This permitted the placing of the jacks between the posts.

The only difficulty met in working on this pier was the necessity of resetting the capstone under one of the posts. To do this we worked two ½-in. flexible cables under the stone through the mortar joint and then attached the tops of these slings to steamboat rachets. The stone was raised as soon as the roller bearings and bed plates had been removed. The old mortar was then cut out and the stone lowered onto a new mortar bed. The slings were then drawn out. The holes made in the end-post channels were closed with rivets after the jacking was concluded.

The crew that accomplished this work consisted in a rigger foreman, four riggers and one carpenter. It took about a week to finish each span, though at no time was it necessary to stop traffic over the bridge. The work was done under the immediate supervision of the writer and the inspection was in charge of the county engineer, J. H. Sieger.

Method of Setting Slope Stakes With Rod, Hand Level and Tape

By Paul McCombs
Roswell, N. M.

AN ACCURATE and quick method of setting slope stakes wherein the only instruments needed are a hand level, a rod and a specially-marked tape is explained in the following paragraphs. The system has been in use by the writer for some time and has proven highly successful.

When Grade is in Cut—Referring to Fig. 1, which is the explanation of the first case, the finished grade is completely in cut. *E* is the center grade stake and *EF* is the height of the observer's eye. *LB* and *OM* are distances out from the finished road edges to the position of the slope stakes, and *IA* and *KD* are rod readings. It is apparent from the figure that the slope stake is to be set at that point at which the rod reading plus the tape reading minus half the width of the road bed equals

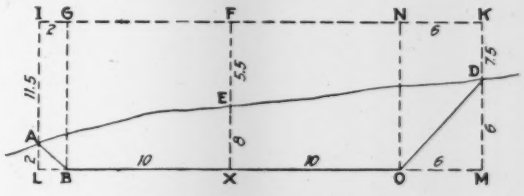


FIG. 1—SETTING SLOPE STAKES IN CUT

the amount of center cut plus the height of the observer's eye.

To the end of the tape is attached a string or wire equal to half the width of the road bed, in this case 10 ft. That makes it possible for actual tape readings to begin at the edge of the road bed so that that half width of road bed is automatically subtracted from any calcula-

tions. In Fig. 1 the slope is assumed as a 1:1. Adding, therefore, the center cut to the height of the eye we have 13.5 ft. The observer stands with his heel at the center stake and takes the loose end of the 10-ft. wire, holding it over the stake. The rodman takes the tape down hill and holds the rod at various points, calling readings on the tape while the observer reads the rod with a hand level. When that point is reached where the tape reading plus the rod reading equals 13.5 ft. the slope stake is set. The process is repeated for the other side.

Should the cut be made on a steep side hill where the total rod readings cannot be taken from the center grade stake, the observer may choose a convenient rod reading such as 10 ft. He then moves on to the point occupied by the rodman, adding in this case 10 ft. to the original distance (center cut plus height of eye). The observer takes the tape at the point held by the rodman and the

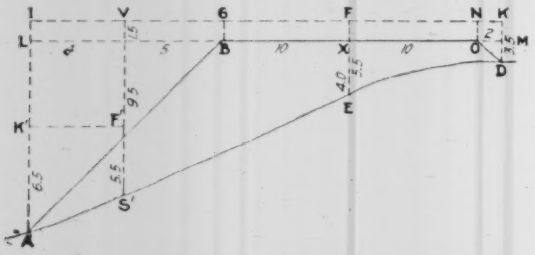


FIG. 2—SETTING SLOPES STAKES IN FILL

process is repeated until the center cut plus the height of eye equals the rod reading plus the tape reading.

When Grade is on Fill—Fig. 2 represents a case wherein a finished grade is entirely on an embankment. As the slope in embankments is usually 1.5:1, in order to simplify calculations, the tape can be turned over and divided into spaces of 1.5 ft. and these spaces subdivided into tenths. The calculations can then be treated as if the slope were actually 1:1.

In this case, referring to Fig. 2, the center fill is 4 ft. and the height of the eye 5.5 ft. Subtracting the center fill from the height of the eye leaves 1.5 ft. The observer then holds the loose end of the wire over the center stake and the rodman goes down the hill until the rod reads 9.5 and the tape reads 5. The observer then moves on to the point held by the rodman, adding 5.5 to his 1.5, making 7. The rodman moves on down the hill until the rod reads 6.5 and the tape reads 9. The sum of the two rod readings is 16 ft., from which is subtracted the tape reading 9, leaving 7. This is the proper point for the slope stake.

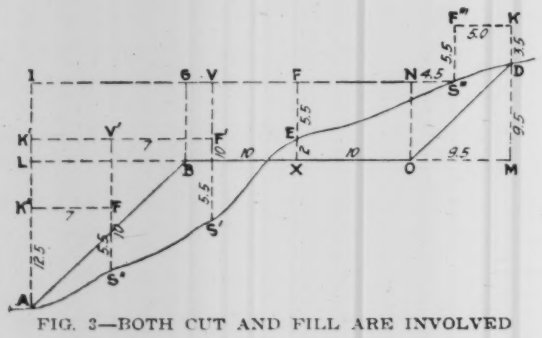


FIG. 3—BOTH CUT AND FILL ARE INVOLVED

FROM JOB AND OFFICE

Hints That Cut and Time

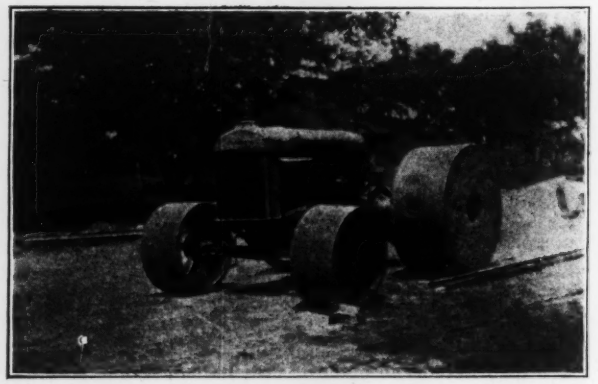
Both Cut and Fill—Case 3 represents a situation wherein the finished roadbed is in both cut and fill. Referring to the figure, the observer holds the end of the wire over the center grade stake, adding to the 2-ft. cut the height of eye, making 7.5 ft. The rodman goes down the hill to a point where a rod reading of 10 ft. is taken, the observer moving on to that point. The height of eye is added to the 7.5 ft. making 13 ft. The rodman continues down the hill to a second point where the rod reads 10 ft. and the tape reads 7. The observer then occupies that point and again adds his height of eye to the 13 ft., making 18.5 ft. The rodman continues down the hill to a third point where the rod reads 12.5 and the tape reads 14. All the rod readings (10, 10, and 12.5) are added, making 32.5. From this is subtracted the tape reading 14 ft., making 18.5. Hence this is the proper point for the slope stake.

There are various other cases than those cited herein, but the general procedure is clear and the engineer who finds this method of setting slope stakes to his liking can apply the general principles to any other cases.

Tractor Is Converted Into Road Roller

By Russell W. Hunt
Resident Engineer, Division of Highways, Vernon, Ill.

By filling with cement the extension rims of the traction wheels of a Fordson tractor a very successful light roller for road work was produced by Mautz & Oren, Effingham, Ill., contractors. The cement filling made the tractor weigh about 5,000 lb., and gave double



CONVERTED FORDSON TRACTOR ROAD ROLLER

roller wheels with 20-in. treads. The front wheels have 14-in. treads.

The heavy steam and horse rollers which were generally used are very unhandy and cumbersome to use between forms. Oftentimes the roller is needed for only a short time, perhaps not over an hour during the whole shift, yet, in the case of the steam roller, steam must be kept up at all times. The improvised roller is ready at any time and with much less trouble does just as good work. It is very easy to handle, can do the same amount of work more quickly and takes up very little space, being left between the forms during operations. The weight of the roller was the only

FROM JOB AND OFFICE

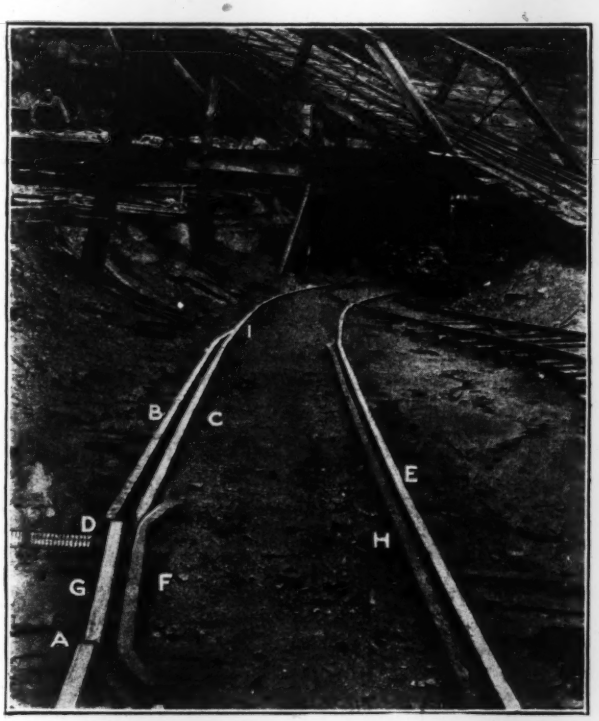
For Contractor and Average Engineer

question in doubt when the roller was considered, but it has proved equal to the demands. It leaves a very smooth and firm subgrade and a much more even surface than the heavier rollers.

While the roller was made primarily to roll subgrade, it is very useful in many other ways. It pulls the turntable, hauls heavy loads of material and is often used to pull the plow.

Track Device Detects Loose Wheels

AT THE Stotesbury mine of the E. E. White Coal Co., Stotesbury, W. Va., an ingenious track device has been designed which detects wheels having too much play and which sounds an alarm when they are found. According to a recent issue of *Coal Age*, with this arrangement no one is required to give his time to inspection as the action of the device is automatic, and



DEVICE FOR DETECTING LOOSE WHEELS

what is more advantageous, each car is inspected every time it passes over the empty track at the tipple.

The inspection is foolproof, for every car that passes over the device is made to sound an alarm if the wheels under test do not continue within the limits of the track gage. One of the several men who work about the tipple will hear the alarm and the car is then run without delay onto the track leading to the shop. With the following description and the illustration shown it is possible for the blacksmith to fabricate the rail of which the device is composed.

Referring to the illustration, the entire length of the detecting track is no greater than that of the standard rail—that is, about 30 ft. This rail length is inserted on the empty or return track leading from the tipple so that the cars pass through it by gravity. To the left of the illustration of this device will be seen the 4-ft. latch rail *G*, fishplated loosely at one end, *A*, so that it may be thrown in line with either of the two rails, *B* or *C*, on the left. A detention spring, *D*, on the forward end of the latch holds it in line with the outer rail, *B*.

Imagine a standard pair of wheels, properly attached to an axle and truly in gage, passing through this track. Rail *C* is in gage with rail *E*, but the guide rail, *F*, attached to the latch rail, *G*, will not pern.it the passage of a left-hand wheel over rail *C* until the latch is swept from the normal position as shown to one in which rail *G* is in line with rail *C*. This is accomplished against the tension of the spring at *D*.

The right-hand wheel is pulled by the guide rail *F* (the gage of which with respect to *H* increases) toward rail *H* until the flange of the wheel comes into contact with it. In this position the flanges of the wheels on either side rub the two guide rails *F* and *H*, and only a small width of the tread on each wheel rides upon the rails *G* and *E*. But as the gage between *F* and *H* increases the latch rail and its guide are pulled into gage against the tension of the spring until the latch lines up with *C*, thus permitting the left wheel to pass over it and out to the point where the trip is made up.

If one of the wheels, being loose, is free to increase the gage between the wheels when passing through this track, the latch will not be thrown, and the wheels will ride upon rails *B* and *E* instead of *C* and *E*. On the ball of rail *B* are welded a number of vertical offsets or humps about one-half inch high. These make the car bump up and down when a wheel passes over them, and this is a signal to the men at the tipple that a defective car is passing over the track. At point *I* is located a small latch loosely fishplated so that wheels riding either on rails *B* or *C* may pass this point.

The entire length of the rail on the right-hand side is fishplated and secured to the ties in the ordinary manner and is paralleled by the inner guide rail, which is bolted to it and held at a distance of 2 in. from it by separating collars through which the bolts pass.

The double rail on the right acts as a raceway, holding the flanges of the right-hand wheels against the inner guide rail. The tension spring at *D* should be strong enough only to pull back the latch to the position shown, after a normal car has passed. A spring with a tension of about 30 lb. should do this work.

The blacksmithing job required is easy. And the cost complete is nominal. The saving made by detecting a loose wheel before it has time to cause a smashup at frogs and switches will repay the expenditure.

Estimating Floor Slabs

Engineering News-Record has been asked what, if any, is the standard practice in estimating that portion of the floor slab which rests in the wall. One prominent New York building contractor says it is part of the wall. Another says the slab. This journal would like comments on the point to see if a definite standard of practice can be arrived at.—Editor.

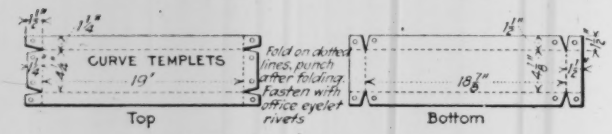
Making Curve Templets of Pressboard

BY H. D. HURLEY

Assistant Engineer, Massachusetts Department of Public Works, Boston, Mass.

MOST CIVIL engineering offices have a set of metal curve templets as a part of their regular equipment. Railroads usually use those of the even-degree type, and highway or general engineering offices the even-inch radius curves. A set of curves can be made quite easily by the individual engineer or draftsman, which will be found useful in small offices or in the field.

The material to use for this purpose is 0.015-in. pressboard. It is a tough durable paper of mottled reddish-brown color. In order to make these curves it will be



DETAILS OF CURVE BOX

necessary to have a metal set to use as a copy. Place the metal curve on the pressboard with the bevel up in order to insure a close edge contact. Scribe all around with a sharp knife, then remove the metal and finish the cut with shears. Cutting all through with the knife is apt to leave a burr.

The writer made a set of the railroad type curves of this paper consisting of a curve every 5 min. from 0 deg. 15 min. to 1 deg.; every 15 min. from 1 deg. 15 min. to 10 deg.; every 30 min. from 10 deg. 30 min. to 15 deg.; and every degree from 16 deg. to 28 deg.—a total of 69 curves.

A box can also be made for the curves with little effort.

Paving Breakers Wreck Reinforced Concrete Meter Vault

COMPRESSED - AIR - operated picks or chiseling machines, commonly used in breaking up pavement for street railway work and trenching, greatly hastened the demolition of a section of building wall and an adjacent Venturi meter vault of reinforced concrete at the Cleveland, Ohio, filtration works. The wall was 20 x 23 ft. and 2 ft. thick reinforced with ¾-in. rods on 8-in. centers. It was demolished in three days. The paving breakers not only broke up the concrete in pieces large enough to be handled by one man, but with the aid of a cutting chisel they also cut off the steel reinforcing side rods. These cutting chisels were similar to those used for asphalt except that the edge was concave so that it would not slip off the bar. Two men operate each machine.

The view shows the paving breakers at work on the side walls of the Venturi vault. These walls are 12 in. in thickness, 51 ft. long and 10 ft. high. They are reinforced in the same way as was the west wall of the building, and were removed in seven days. The roof of the vault which was of the same dimensions and construction as the sides, was removed in 3½ days. This work it is stated would have taken many more men a much longer time to do if hand methods had been used, and would of course, have been much more expensive.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

PNEUMATIC PICKS WRECK REINFORCED CONCRETE VAULT OF FILTRATION WORKS

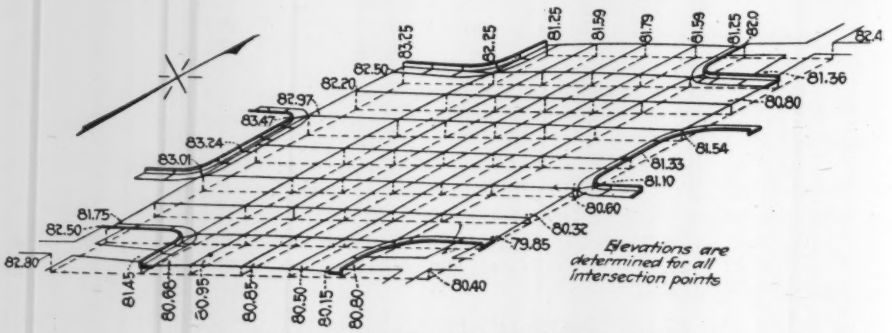
M. A. O'Brien, Secretary and Treasurer of the Lake Erie Construction Co., of Cleveland, Ohio, supplied this information. The work is in charge of Supt. William Maloney. The paving breakers were manufactured by the Ingersoll-Rand Co., New York.

Street-Intersection Grades Determined by Aid of Isometric Projection

BY L. R. DOUGLASS

of Douglass, Corey & Fiske, Engineers, Trinidad and Walsenburg, Colo.

DETERMINATION of elevations at street intersections is a problem over which many theories have been advanced, and to which much discussion has been given in the technical press. The difficulties of solving the problem satisfactorily are increased when intersecting grades are steep and elevations at the curb angles



VISUALIZING EXISTING AND FINISHED GRADES

FROM JOB AND OFFICE

For Contractor and Average Engineer

vary, rendering impracticable the use of the usual formulas.

This office, in working out street intersections in Trinidad, found the problem a difficult one in view of the fact that the city is situated in a mountainous section of the state, the topography being steep and hilly.

In developing a satisfactory method of working out these intersections it was necessary to visualize them. The method of platting on an isometric projection was therefore tried out. The idea was to plat the intersection so as to show both plan and profile at any point and as a whole. A convenient datum was selected which was passed under the 30-deg. isometric projection of the intersection, showing the exact relation between the existing elevations of the intersection and the proposed elevations of street, curb and gutters

Results by using the isometric projection method have proved highly satisfactory.

Assembling and Spacing Reinforcement in Pavement Slabs

SPECIAL methods to ensure the accurate positions of reinforcement in concrete pavement slabs are provided in the standard plans of the New Jersey State Highway Commission. Both pre-woven fabric and assembled-bar reinforcing sheets are employed.

If bar reinforcement is being used the arrangement indicated by Fig. 1 is employed for assembling the bars. This wooden frame is set on horses about 2 ft. above the ground so that a workman can step inside between the bars to make the wire ties and for other operations. Woven fabric is received in flat sheets of the proper size and ready to be put down.

When the sheets are assembled they are spread with the proper lap on the sheets previously placed, on the grids of pipe shown by Fig. 2. These pipe grids hold the sheet off the subgrade until the concrete is deposited. Then the grids are pulled ahead and another sheet of reinforcement is placed. When there are two layers of reinforcement they are assembled, as indicated, with spreaders to hold them the proper vertical distance apart.

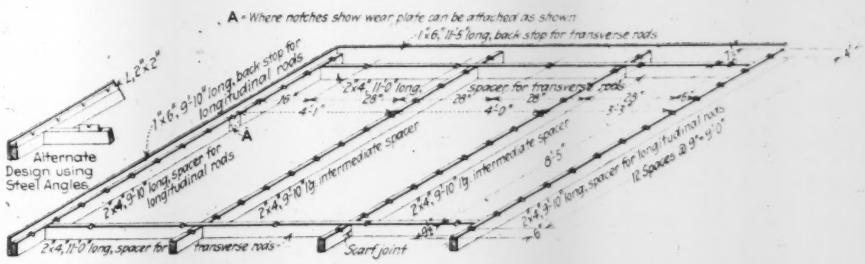


FIG. 2. PIPE GRID PULLED BY PAVER SPACES SLAB REINFORCEMENT

T. J. Wasser is state highway engineer of New Jersey with C. F. Bedwell as construction engineer.

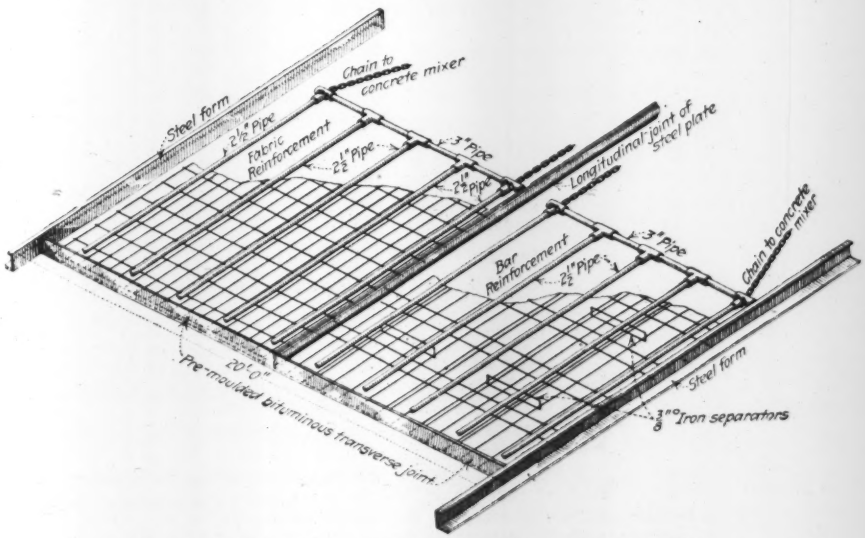


FIG. 1. FRAME FOR ASSEMBLING BAR REINFORCEMENT

Laying Asphalt by Artificial Light

Night work placing asphalt surfacing on the plank roadway of the Victoria Bridge, near Montreal, Canada, disclosed a number of difficulties due to artificial lighting. A $1\frac{3}{4}:2\frac{1}{2}:1\frac{3}{4}$-in. surfacing was required on a surface-worn plank roadway 6,400 ft. long and 14 ft. wide, and the only time the contractor had access to the bridge for construction operations was from 11 p.m. to 6 a.m. The ordinary bridge lighting was not sufficient, so it was found necessary to use high-candlepower, portable searchlights. Three rakers and an average of eleven shovelers were employed to spread the mixture. These men worked under difficulties, caused mainly by inefficient lighting and narrowness of the roadway. It was extremely difficult for the rakers to spread the material to the thickness required because of the many shadows which gave false impressions of variations in contour of the pavement. The roller engineer encountered some difficulties from this same cause, and found it very hard to operate the roller along the inner guard rail. Working six or seven hours facing the strong lights was a great strain on the eye and nerve. The bad condition of the plank flooring made raking difficult, for many splinters were lifted by the shovels and these made the mixture hard to handle.

Electrolytic Corrosion of Steel Water Main at Akron, Ohio

SEVERE corrosion of about 1 out of 11 miles of the 36-in. steel force main of the water-works of Akron, Ohio, was found after considerable expert investigation to be due to mild stray electric current leaving the main to journey three miles by a low ground-resistance route to a power house. The case is reported in detail in the September *Journal* of the New England Water-Works Association by G. Gale Dixon, chief engineer, Akron Bureau of Water-Works Improvements, and Victor B. Phillips, of Crecelius & Phillips, Engineers, who investigated the electrolytic conditions for Akron. Additional information and opinion are contributed by F. A. Barbour, Boston, who was consulting engineer for the city when the pipe was laid. A number of other specialists were engaged in one or another phase of the investigation, one of the main objects of which was to throw light on the advisability of using steel for a parallel line of 48-in. main required by the City of Akron. Steel was finally used for the second line, except that 0.9 miles across the low-resistance ground was laid with cast iron before the exact cause of the corrosion had been determined and a nearly complete electric balance established. Lock-bar pipe was used for both of the steel pipe lines.

Mr. Dixon states in his paper that the first or 36-in. main was constructed in 1913-14 and put in operation in August, 1915. The pipe was actually distributed along the line between Nov. 21, 1912, and April 23, 1913. The pipe laying was started in May, 1913, and completed in July, 1914, "so all of the pipes were exposed to the weather of practically a full winter season, while a portion of it was on the ground during two winters, but this was not the portion of the pipe which was seriously damaged by corrosion."

In May, 1919, the pipe was uncovered at eight points in wet clay ground as a part of the studies for the parallel pipe line already mentioned. Mr. Dixon states that "in all cases the condition was found to be good; the coating in some spots was brittle and in others thin or easily removed, but no pitting was observed nor rust under loose coating." Equally good conditions were found at several other inspection tests not far distant.

Interior Condition—In November, 1919, on account of surface indications of leakage that had been observed for some time, an interior inspection of the pipe was made at a point in what was afterwards found to be the badly corroded area. Two holes entirely through the plate were found to be the source of leakage (previously attributed to ground water rather than to any defect in the pipe). The two holes were plugged from the inside and a 60-ft. length of pipe was uncovered, "showing a very severe condition of corrosion" both inside and outside the pipe, with three or four times as many pits above as below the horizontal line. Quoting now from Mr. Dixon's paper:

> Inside, the original coating showed numerous blisters from from ¼ to 1½ in. in diameter, which when punctured and removed disclosed bright steel with a slight roughness in the center; in other places tubercles were found covering shallow "saucer shaped" pits. On the exterior, the "cup shaped" pits usually contained at the bottom a small quantity of material resembling white lead paste, though in some cases a pale brownish color was observed.

In several places long shallow pittings apparently followed where the coating had been scratched by a pick or shovel in backfilling, and in another case near the end of a pipe a similar condition had followed abrasion due to the cable sling with which the pipe was handled.

Up to the early part of 1921 a total of nearly twenty holes had manifested themselves by leakage that had been plugged from the inside of the main.

The 60-ft. length of pipe line that had been bared, Mr. Dixon states, was "carefully cleaned, the deeper pits flushed up with metal by the oxy-acetylene flame, and the pipes were painted with 'Hermastic Primer' followed by 'Hermastic Enamel' applied hot. The trench was underdrained and backfilled with clean sand and gravel."

Altogether a number of different investigators were called in before the engagement of Crecelius and Phillips. Tests were made to determine the flow of electric current and also to throw light on the possibility of both soil and water conditions being responsible for the corrosion. Current flow tests were also made by Mr. Phillips in conjunction with the engineering force of the Northern Ohio Traction & Light Co. At one of these tests assistance with special instruments was rendered by E. R. Shepard of the U. S. Bureau of Standards. In April and May, 1921, the company just named, according to Mr. Dixon, established "electrical balance with the force main by re-bonding its tracks in the vicinity" of three of the company's sub-stations, installed a negative feeder at another point.

Conclusions—In the final report dated June 23, 1921, Crecelius and Phillips summarized their conclusions as follows:

1. That electrical conditions on the system of the Northern Ohio Traction & Light Co. are at this time so balanced as to eliminate the presence of current in serious quantities on the steel force main.
2. That there exist no geological formations that may serve as a natural battery with resultant galvanic currents.
3. That there be no danger from soil corrosion.
4. That there exist local galvanic currents due to presence of scale and also possibly to differences in the composition of the metal; and that the mains should be inspected from time to time to determine the seriousness of such local galvanic currents.
5. That periodic tests to determine current flow on force mains should be made in the future and that permanent test stations for such measurement may be installed to advantage.
6. That conditions are such as to permit the use of steel pipe without unusual danger (especially inasmuch as cast-iron pipe has already been laid in the dangerous area near Tallmadge).

In the paper by Mr. Phillips already mentioned, there is given the following explanation of why stray currents damaged this particular mile out of the 11 miles of the force main:

> A study of the geology and topography of the country between Tallmadge and the Gorge substation disclosed the fact that there was an almost continuous low resistance path, due to creek beds and wet ground. The current was simply following this path.
>
> Having established the fact that there was a measurable flow of current off the force main near Tallmadge directly across country to the Gorge substation, it was then necessary to determine the reason for the current taking this long, roundabout and comparatively high-resistance path. At least one contributing cause was found to have been in the rather long stretch of poorly bonded track between the High St. substation and the Gorge substation. Thus, a

certain part of the power originating in the Gorge substation positive feeders had to find its way back to the Gorge substation negative bus by another path than the high-resistance rail circuit. This increment of current then followed the tracks of the railway system into the High St. substation and thence through a bonded connection into the city water system and into the steel force main. It should be pointed out that the route followed by the railway, as well as the city of Akron, is all on high well-drained and consequently dry ground, so that there were no low-resistance ground paths by which this current might have taken a shorter route to the Gorge substation.

In his discussion of the two papers by Messrs. Dixon and Phillips, Mr. Barbour stated that "the experience described should not be interpreted as an argument against the use of steel pipe." Mr. Barbour also took up the question of the original coating of the pipe and its winter exposure as already mentioned. After giving some interesting general information on this matter of coating, Mr. Barbour stated positively that the corrosion of the Akron line was not due to "failure of the coating or to soil conditions or to local galvanic currents resulting from mill scale, or other causes of potential differences in the pipe," but was due entirely to "stray electric currents—the unusual condition being the great distance between the pipe line and the nearest electric railway tracks."

Thirteen-Ton Concrete Slab Moved To Repair Reservoir Floors

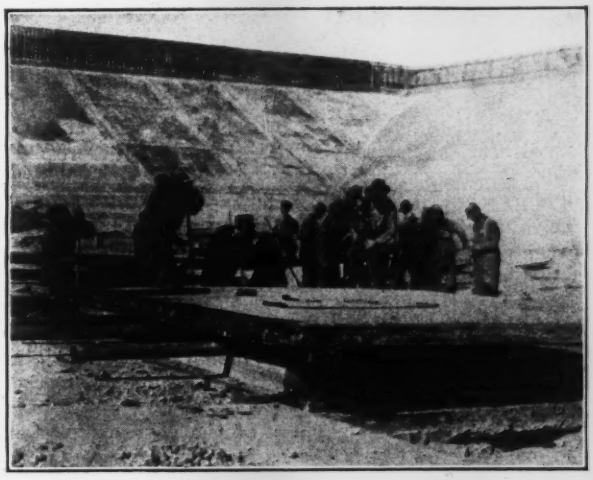
When Leaks Made Renewal Necessary 50 Slabs Were Rolled Aside While New Concrete Foundation Was Placed

A CONCRETE lined reservoir in Arizona developed leakage which could not be stopped by ordinary sealing processes because the escaping water had so undermined the foundation that the concrete footings seemed to have been affected; at least it was certain that mere surface sealing was ineffective because under water pressure the seal was broken by the movement of the concrete floor on its unstable base. The repair of the reservoir was started on the plan of breaking up the concrete and pouring a new paving on a new base. In doing this it was discovered that the concrete in the floor itself was in good condition. The original floor was laid in slabs 17 ft. square separated by ½-in. expansion joints filled with an asphaltic compound. It seemed a waste to break up these slabs for the sole purpose of getting at the foundation and the contractor decided to try to move them aside bodily and later return them to the reconstructed foundation. This plan was carried out and after a little practice was applied expeditiously over the entire reservoir floor. A total of 50 six-in. slabs, weighing about thirteen tons each, were moved without injury, the average move for a slab being about 18 ft.

The asphalt on the slabs and in the joints was first removed by burning as described in *Engineering News-Record* Oct. 27, 1921, p. 703. This made it possible for a crew of about twenty men, by prying against the adjoining slabs with crowbars, to raise a slab high enough to get jacks and blocks beneath it. After experience with the first few slabs it was found that the jacks could be supported on the concrete footings and runways of 8 x 12-in. timbers and rollers of 4-in. pipe, 14 to 16 ft. long, could then be used to move the slab to one side. When ready for rolling the slab was supported on four or five of the pipe rollers which turned between the timber runways below and a 6-in. timber placed on the under side of the slab to give the rollers a smooth bearing and distribute the load.

As the slabs were removed the foundation was seen to be in bad condition, having been "puddled" by the escaping water. From 3 to 5 cu. yd. of mud was removed from beneath each slab and this space refilled with concrete mixed by hand as needed on the floor of the reservoir. Eight to ten slabs were removed at a time and after placing the concrete it was left to set before replacing the slabs. After the slabs were put back in place a hole was cut through the center of each one and grout was poured in to give the slabs a uniform bearing on the foundation.

With the floor slabs leveled up and grouted the next step was to fill the joints with a soft mineral fiber pressed into position with a trowel. This soft compound was protected against water pressure by the addition of three layers of fabric and finally sealed with a carbon gum. The last operation was to paint the entire inner surface of the reservoir with a black waterproof paint and cover this with a cement "lotion" which covered all traces of the black compound. The cost of this final cement finish, including its application, was about ½c. per sq.ft.



MOVING A 13-TON SLAB IN THE RESERVOIR FLOOR

Note the undermining of footing in the foreground. Jacks supported on these footings lifted the slabs which were then rolled aside until new foundations were placed.

Although the repair of the reservoir as a whole was done in a series of several operations, the work on the floor involving the moving of the slabs bodily was done in the equivalent of about sixty days with a crew of from twenty-five to thirty men. The cost of doing the work in this way is estimated to have been about 50 per cent of the sum which would have been required to break up the old concrete and pour an entirely new floor.

The foregoing account of the work is based on information supplied by the Waterproof Paint Co. of Lankershim, Cal.

Determination of Rail Wear for Valuation Purposes

Cross-Sections Accurately Measured in Field—Rails Rated by Scientific Analysis of Observed Deterioration

By J. P. Newell
Consulting Engineer, Portland, Ore.

THE difficulty of accurately measuring the wear of rails in the track has hitherto made the inspection of rails in valuation work almost entirely a matter of the judgment of the inspector. In the Grand Trunk arbitration, with 10,000 miles of track to be examined for actual purchase, a more definite method of procedure was desirable. It was made possible by the invention of a rail pantograph by S. W. Fairweather, office engineer of the government staff.

The Rail Pantograph.—The distinguishing feature of this instrument are a curved arm which can be rotated about its axis without changing the position of the tracing "point," and which carries a second arm mounted on an axis at right angles to the first and capable of being similarly rotated; and the substitution of a tiny wheel of hard steel for the usual sharp point. In other respects it is like an ordinary pantograph except that it is made of heavier material. It is mounted on a board about 18 in. square which can be clamped to the head of the rail to be measured. The curved arm enables the entire rail section to be reached at one setting, and the wheel runs smoothly over the surface, where a point would be continually catching. The rail section is traced on a card fastened to an upper corner of the board. The accuracy of the instrument is tested each time it is used, by the closure of the drawing, and means are provided for adjustment. The drawing is larger than the true section by the radius of the wheel at the point, $\frac{3}{4}$ in. The accompanying photographs show clearly the construction and method of use.

Each track-inspection party of the government staff had one of these "ouija boards," as they were promptly dubbed. Rail sections were taken at frequent intervals, taking both rails on curves, and notes made on the cards of the mile-post location, position in the track, size, date and brand of rail and track in which it was found. About 9,000 sections were measured, and the cards are on file at Ottawa.

A traffic study made in the course of the investigation calculated the gross tonnage of freight cars and locomotives in each direction over each track for a year. Similar figures for passenger traffic could be easily obtained, and close approximations of both for other years could be made. This, taken together with the rail sections, furnishes valuable material for a study of the effects of traffic on rail wear.

Field Methods—Deterioration of rail by wear manifests itself in one or more of six ways: (1) top wear, (2) side wear, (3) depression of the ends by wear and bending, (4) surface roughness, (5) surface bending, (6) kinking.

The first two were shown accurately by the measured sections. The third was measured by a four-foot steel straight-edge laid across the joint. A graduated wedge, applied at the end of the rail, measured the deflection in 64ths of an inch. The other three conditions were estimated by the inspectors, who were instructed to mark each by *O* for no perceptible wear, *A* for a small amount, *B* for a moderate amount, *C* for a bad condition, and *D* too bad to continue in use. These were recorded in the order given above. Thus if a rail card were marked *ABC*, it would indicate that the rail whose top and side wear were shown by the section on the card, and end wear by the number of 64ths of an inch depression, had a perceptible surface roughness, a moderate amount of surface bending and was kinked about as badly as could be permitted. A rail marked *D* must be scrapped or changed to an inferior service, regardless of the other markings. These letter gradings were made with regard to the service in which the rail was found. Thus a given marking for a rail in branch line track indicated a greater amount of wear than the same marks for a main line rail.

Standards for Rating Rail—In reducing the data collected by field engineers to numerical expressions of condition per cent, recourse was had to the standards for relay and scrap rail. It was considered that rail in service, found to be worn to the same extent as the average of rails bought and sold as relay was depreciated by the difference in price between new rail and relay; the same for scrap.

Prices of relay and scrap vary with local conditions but it was estimated that, considering the whole country served by the Grand Trunk, scrap rail would average one-third of the price of new rail and relay two-thirds. This means that one-half the wearing value is used up in main line service and the other in branch lines or side tracks. These ratios may be quite different under other conditions.

Deterioration of rail, if of considerable extent, always manifests itself in more than one way. Specifications for relay and scrap rail are made with this fact in mind. In order, however, to give a numerical value to each kind of wear, it must be considered alone, in which case the specifications would be somewhat relaxed. On the other hand, the specifications represent limits, and the average condition of either relay or scrap is a little better than these limits. These two conditions were considered as about balancing each other, and the limits given by the specifications for each kind of wear as permitted for relay or scrap were taken as representing the average for that kind of wear alone.

Combination of Ratings—The depreciation from several forms of wear existing together is obviously not the arithmetical sum of the percentages of depreciation which would be due to the various causes considered separately. A rail which is badly side-worn is less damaged by a given amount of end-bending than one which is otherwise perfect. It is therefore necessary to establish percentages of depreciation corresponding to combinations of wear in various forms. The procedure adopted was first to rate the rail for sectional and end wear combined, and then enter a second table with the depreciation thus obtained and find an additional amount to cover the three other forms of wear.

The specifications used were those of R. W. Hunt & Co. and the Canadian Pacific Ry. The method of making up the tables for a 100-lb. rail will be described. The maximum top wear permissible for No. 1 relay is $\frac{7}{16}$ in., which on the rail used by the Grand Trunk represents a loss of area of head of rail of 10 per cent.

This amount of wear therefore represents a depreciation of 50 per cent without other defects. The greatest loss of area by top wear found in service was 35 per cent. This percentage was taken as the maximum permissible, the corresponding depreciation being therefore 100 per cent.

The maxmum side wear for relay was taken at $\frac{1}{4}$ in. which equals 8 per cent of area of head. Side wear of 25 per cent on one side calls for scrapping as the bearing is then so far to the outside of the head that failure is likely to occur. Side and top wear rarely occur together to a marked degree. Where both were found, it was the rule to add one-quarter of the smaller to the larger and apply the rating accordingly.

For end wear a depression of $\frac{1}{8}$ in. in 2 ft. was taken as the maximum for relay. The cost of cutting off rails plus the loss of length equals about 25 per cent of the wearing value; consequently depreciation from end wear is limited to 25 per cent in addition to that due to sectional wear, except that a shortened rail would always be depreciated 50 per cent. One-half inch depression has been taken as indicating 100 per cent depreciation, except as limited by cutting-off.

PANTOGRAPH USED TO DETERMINE RAIL SECTIONS

These pictures show the pantograph in three different positions with reference to a rail section. The curved main and secondary arms permit movement of the hand-hold without changing the position of the tracing point, so that the entire section may be reached at one setting. The "point" consists of a tiny wheel of hard steel which prevents catching on the rail surface which might be caused by a sharp point.

TABLE I—RATING TABLE FOR 100-LB. RAIL

Per cent Depreciation for Sectional and End Wear

Per Cent Top Wear	Per Cent Side Wear	End Wear in Sixty-fourths of an Inch: 0	2	4	6	8	10	12	14	16	18	20	26	32
0	0	0	13	25	37	50	...	...	...	...	...	...	...	...
1	...	5	18	30	42	50	...	...	...	...	...	...	...	...
...	1	6	19	31	44	50	...	...	...	...	...	...	...	...
2	...	10	23	35	47	50	...	...	...	...	...	...	...	...
...	2	13	25	38	50	...	...	...	...	...	...	...	...	...
3	...	15	28	40	50	...	...	...	...	...	...	...	...	...
...	3	19	31	44	50	...	...	...	...	...	...	...	...	...
4	...	20	33	45	50	...	...	...	...	...	...	...	...	...
5	4	25	38	50	50	...	...	...	...	...	...	...	...	...
6	...	30	43	51	53	55	55	...	...	...	...	...	...	...
...	5	31	44	51	53	56	56	...	...	...	...	...	...	...
7	...	35	48	52	54	55	59	60	...	...	...	...	...	...
...	6	38	50	52	54	56	59	62	63	...	...	...	...	...
8	...	40	51	53	55	57	60	63	65	...	...	...	...	...
...	7	44	52	54	56	58	60	63	66	69	...	...	...	...
9	...	45	52	54	56	58	60	63	66	70	...	...	...	...
10	8	50	53	56	57	58	60	63	67	70	73	75	...	...
20	...	70	71	72	73	73	74	74	75	75	75	78	88	95
...	15	72	73	74	75	75	75	76	76	77	77	78	89	97
35	25	100	100	100	100	100	100	100	100	100	100	100	100	100

Table of Sectional and End Wear—The controlling points in Table I have thus been established as follows:

10 per cent top wear
8 per cent side wear
8/64 in. end wear
} = 50 per cent depreciation.

and the following combinations were added:

2/64 in. end + 7.5 per cent top or 6 per cent side
4/64 in. end + 5.0 per cent top or 4 per cent side
6/64 in. end + 2.5 per cent top or 2 per cent side
} = 50 per cent depreciation.

35 per cent top wear
25 per cent side wear
32/64 in. end wear
} = 100 per cent depreciation.

The remainder of the table is supplied by interpolation, bearing in mind that any form of wear has but little effect upon depreciation until it becomes equal to the other kinds of wear found with it. Tables were worked out for each per cent. In the one here presented this is done only as far as 10 per cent top wear.

The Grand Trunk has a 79-lb. rail with a deep narrow head and metal of a very high quality. On this account the controlling percentages were fixed as follows:

13 per cent top wear
8 per cent side wear
8/64 in. end wear
2/64 in. end + 10 per cent top or 6 per cent side
4/64 in. end + 6.5 per cent top or 4 per cent side
6/64 in. end + 3.0 per cent top or 2 per cent side
} = 50 per cent depreciation.

45 per cent top wear
20 per cent side wear
32/64 in. end wear
} = 100 per cent depreciation.

Controlling points were fixed in a similar manner and tables made for each size of rail.

Effect of Other Depreciation—The effect of the remaining causes of depreciation decreases rapidly as sectional and end wear increase. As already pointed out, the ratings on account of these causes indicate a greater amount of depreciation the lower the grade of service in which the rail is found.

In fixing the controlling points in the table of additional depreciation due to surface roughness, surface bending and kinking, it was estimated that the loss of service value in the main line rail marked by the inspecting engineer *CCC*, but not otherwise deteriorated at all, is about three-quarters as much as that of relay rail, or 36 per cent. To main line rail depreciated to relay by end and sectional wear, *CCC* was considered to add only 10 per cent. If the rail were depreciated 100 per

cent from any cause, the same mark would add nothing to it. With these three points fixed, the remainder were interpolated in such manner that they decrease rapidly at first, with increase of sectional wear, and much more slowly after the latter reaches 50 per cent.

For important branch lines the same marking was taken as giving values of 42 per cent, 15 per cent and 0. For secondary branch lines 50 per cent, 20 per cent and 0; for siding rail, 60 per cent, 25 per cent and 0.

The *AAA* marking was taken as equal to one-sixth as much as *CCC*, but as reducing to 0 by the time sectional wear reaches 50 per cent. *BBB* was considered as equal to approximately one-half of *CCC*. The method of interpolation is sufficiently indicated by Table II

TABLE II—ADDITIONS TO RATING TABLE READINGS ON ACCOUNT OF SURFACE-ROUGHNESS, SURFACE-BENDING AND KINKING

Per Cent Section and End Wear	Main Line Rail												
	AAA	OAB	AAB	OBB	ABB	AAC	BBB	ABC	BBC	ACC	BCC	CCC
	OOB			OOC	OAC		OBC		OCC			
0	6	8	10	12	14	16	18	20	24	26	30	36
10	4	5	7	8	10	11	13	14	17	19	22	26
20	3	4	5	6	7	9	10	11	13	14	16	20
30	2	3	4	5	6	7	8	9	10	11	13	16
40	1	2	3	3	4	5	6	6	8	9	10	13
50	0	1	1	2	3	3	4	5	6	7	8	10
60	0	0	1	2	2	3	3	4	5	5	6	8
70	0	0	1	1	2	2	3	3	4	4	5	6
80	0	0	1	1	1	2	2	3	3	3	4	4
90	0	0	0	0	1	1	1	1	1	2	2	2
100	0	0	0	0	0	0	0	0	0	0	0	0

which gives the additions for each marking to be made for each 10 per cent of depreciation from sectional or end wear. This table is used for any main line rail.

Use of Tables—The tables were used in this way: A tracing of the rail, with various percentages of wear shown on it, was applied to the drawing on each card, as turned in by the field forces, and the approximate loss of head by top or side wear, or both, noted. With this percentage and the end depression given on the card, the depreciation was found by Table I. This figure was then found in the first column of Table II, and the addition corresponding to the letter grading on the card found in the appropriate column.

For example: A rail card showed a section of 100-lb. rail which had a top wear of 6 per cent, no side wear, end wear $\frac{3}{64}$ in. grading *AAC*. Table I for 100-lb. rail, gives 43 per cent depreciation. Table II shows an addition of 4 per cent. Total depreciation 47 per cent.

Satisfactory results were obtained by this method of inspection on the Grand Trunk, but after the rejection by the board of arbitrators of the estimates of cost of reproduction offered by the company, it was thought best by counsel for the government to withhold evidence as to percentages of depreciation. The results were therefore not subjected to adverse criticism. In any case, differences of opinion would doubtless exist as to the relations between the values of new rail, relay and scrap, and the effects of different kinds and degrees of wear, but after these factors were fixed there should be but little variation in the application of the rules.

Great Britain's Highway Mileage

The total length of all highways in Great Britain, according to a statement by Sir Henry Maybury, director of roads, Ministry of Transport, in a recent address before the Institute of Transport, is computed as 177,306 miles. The results of the classification of roads show 22,160 miles of first-class and 14,419 miles of second-class roads.

Applying Efficiency to the Production of City Maps

Sectional Tracings, Embodying Primary Data, Printed in Duplicate—One Set Is Basis for Working Maps and Other for Special Uses

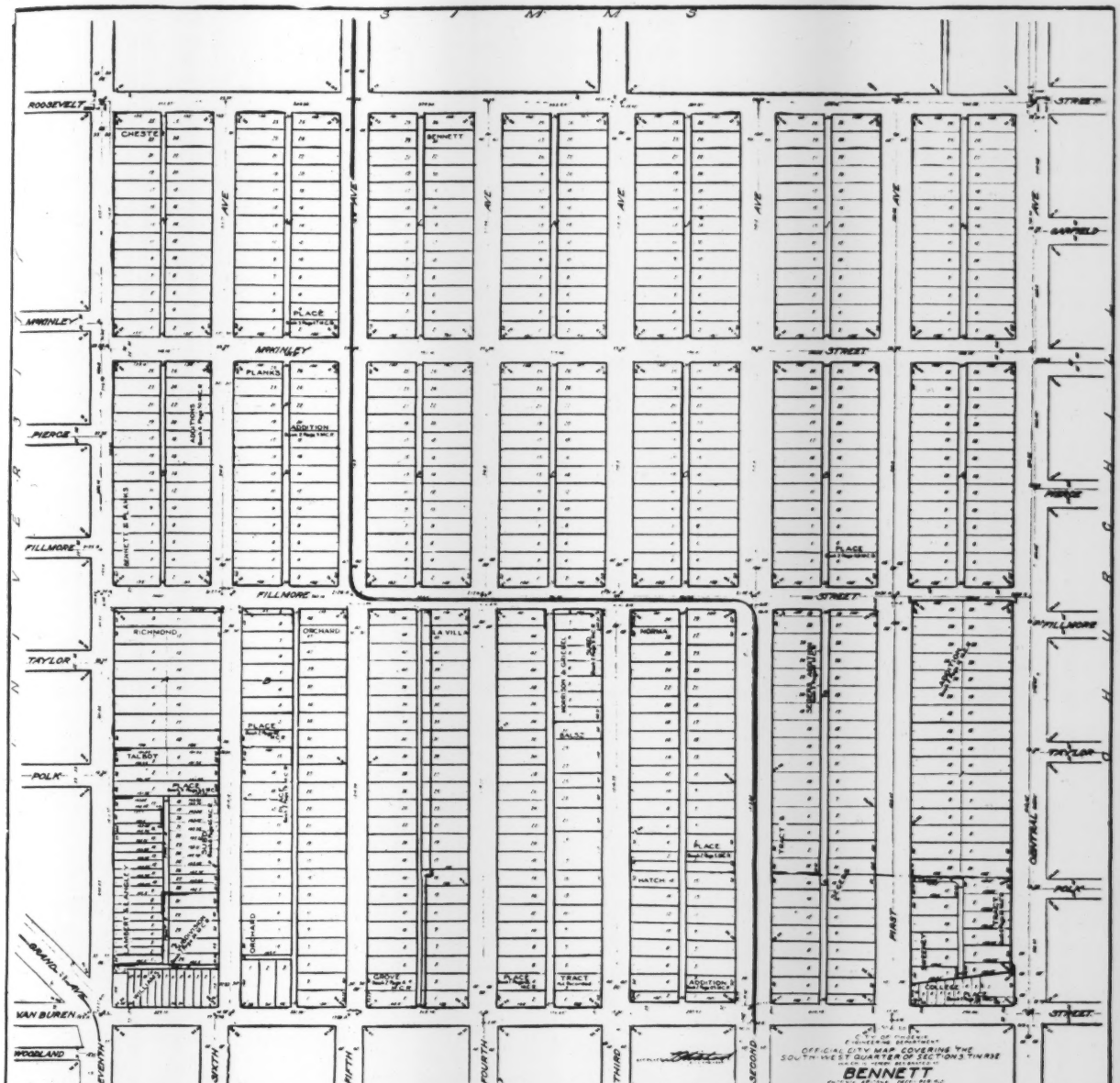
By S. M. Cotten
Civil Engineer, Phœnix, Arizona

THE ROUTINE work of the average city engineering department consists largely in the continual preparation of maps of the city or parts thereof. Such maps are required for a variety of uses; primarily, to show accurately the location of streets, land subdivisions, and other fixed characteristics; thereafter, to delineate assessment or improvement districts, to show the location of sewers, water mains and other public service installations, and to show special districts being studied for special purposes. The character of the work is such that maps of the same scale are suitable for all these purposes, but unless some system is devised to avoid it, the bulk of the work in the preparation of such maps will be but a repetition of similar effort previously expended.

Preparation of Sectional Tracings—The system now in use in the engineering department of the City of Phoenix has resulted in a great economy of time and money, and has made it possible to prepare acceptable office records inexpensively. The prerequisite to adoption of this system is a set of sectional maps of the city, on tracing cloth, uniform as to size and appearance, and carrying upon them all data of primary importance. The scale of the maps should be large enough to show clearly all information, both present and anticipated. The size of sheet selected will be determined somewhat by the natural subdivisions composing the city, but should be as large as possible, though not unwieldy. Since these maps are to be indirectly modified and reproduced to serve as the basis for special maps, care must be exercised to arrange street names and other lettering so that this will conflict as little as possible with the other purposes to which the map is to be put.

The City of Phoenix embraces an area of 5.16 square miles, and is situated in a region where the original subdivisions of record are the sections and quarter-sections established by government survey. Consequently, the quarter-section immediately suggested itself as the logical unit for the sectional maps, particularly in view of the fact that without exception the city has continuous and fairly uniform streets along all sections and quarter-section lines. A scale of 100 ft. to the inch was adopted. In order to have each map complete data pertaining to streets bounding the limits of each map were shown. The name and number of the abutting map sections were shown on the corresponding border of each map, so that it is possible to move from one map to those adjacent without any break in the continuity. Each quarter-section map was given an official designation. In view of the purposes to which these maps were to be put the street names were put only at the bottom and at the left of the sheet, whenever possible, and outside of the area of that particular quarter-section. Intersecting streets were shown for a distance of about two inches outside of the bounding streets.

Data Included on Tracings—In addition to street locations and names, these maps carried the following;



MAIN TRACING FROM WHICH SPECIAL USE DETAIL MAPS ARE MADE

On this map are included the following data: Subdivision name under which property is recorded, block and lot numbers, survey monuments, grade elevations of property corners at street intersections, and street-railway and railway tracks and rights-of-way. These tracings are large enough to allow matching up with adjacent ones.

1. The name of the subdivision under which the property is recorded, and a reference to the book and page of official record. This designation was so placed as to appear partly in the northwest and partly in the southeast corners of the subdivision, and the outlines of the subdivision were further indicated by a broad red ink line just inside the property line.

2. The name or number of blocks and lots, the recorded dimensions of the latter, and the width of streets and alleys. The figures showing the dimensions of lots were set back sufficiently from property lines so as not to interfere with the subdivisional boundary lines, if any, and the lot numbers were placed near, but not on, the rear line of the property. This left the lot clear for any other notations that might seem to be desirable

3. The city survey monuments, of which there is at least one at each street intersection, together with a number for each one. Each east and west street was given a number, likewise each north and south street, and these numbers apply to these streets from end to end of the city. Each street intersection has a number then which is the combination of these street numbers, always in a certain form, and the monuments take the numbers of the street intersections, with suitable alphabetical subscripts when an intersection has more than one monument. These monuments lie on a straight line for each street or portion thereof, and this "stone line" was shown, together with the rectangular offsets

from the same to the adjacent property lines: also, the distances from stone to stone as determined by city survey.

4. The grade elevations of property corners at street intersections and other points, as established by ordinance, and the elevations of the city monuments.

5. Street railway tracks and railroad tracks and rights-of-way.

The overall size of the maps is 31½ in. x 34 in. A 2½-in. binding border was provided at the left of the map, and a ½-in. border on the other sides.

The completed set consists of twenty-six maps. Three draftsmen were employed on this work at different times for a period of about six months. Each map was prepared complete by the draftsman to whom it was assigned, with the exception of the title. The work of these three men was ordinarily very dissimilar in appearance, but by adopting standard procedure respecting every detail of these maps, results were secured which were extremely uniform.

Before beginning the preparation of the sectional maps a traverse net for the city as a whole was plotted along all section and quarter-section lines, and the co-ordinates of control corners for each quarter-section were computed. The necessary data were on hand from previous surveys and general office records. The co-ordinates of control corners for each sectional map were so laid off that the side border lines lay in a due north and south direction, so that all maps are oriented with respect to the same north line when placed side by side. The plotting of the control corners by co-ordinates also insured a degree of accuracy and uniformity impossible to secure otherwise.

Preparation of and Use of Negatives—From these tracings were printed two sets of negatives. Prints from one set were used as the working maps for the office, and then filed for subsequent use; on the other set of negatives the stones, stone lines, grade and stone elevations, and stone distances were blocked out, using a payzant pen or brush and black drawing ink. These negatives give a print free from detail that would only be in the way for various plotting purposes. Such maps are suitable for use in various city departments.

Use of Prints—From the altered negatives was made a set of brown-line prints on thin paper of the best grade, from which very good blueprints or negatives are procurable. This set of maps was filed, is kept intact, and is used primarily in connection with the preparation of improvement or assessment-district diagrams. The boundaries of assessment districts are laid off on the thin brown-line prints in light-colored pencil lines, and a negative made of that portion of the map. A sheet slightly larger than the overall size of the finished diagram is cut from paper such as is used to wrap sensitized papers. An area is cut from this sheet such that the opening will just fit around that portion of the negative to be printed and the negative is attached to the mat by gummed stickers. The titles and legends which appear upon these diagrams being practically identical in all cases, negatives for them have been prepared in quantity, and are set into the mat just as in the case of the map portion above described.

From this mat-negative a thin brown-line print is made. On this print is lettered in black drawing ink, the required data, such as assessment numbers, areas of lots, outlines of the street improvement, and the omitted portions of the title and legend. We now have the equivalent of a tracing of the diagram, for the specific purposes in view without having had to draw a line or set down a figure so far as the map proper is concerned. We have used only a small fraction of the time which a tracing would have required, and the expense of the prints and material used is negligible. Furthermore, we know that the map features of the diagram conform absolutely to the official city map of that area, and that draftsmen's reproduction errors are eliminated.

From the completed brown-line print and additions, is made a negative, and from this as many blue-line prints as required. These final prints, while possibly lacking something of perfection, are good, clean-cut specimens and give no hint of their composite origin. One copy of these prints goes to the contractor for that improvement job, and is delivered by him to the bond house that purchases the bonds.

If the assessment district extends beyond the limits of one map, the condition is easily met. We have had them which embraced portions of six maps and have not found this to interfere with the efficient operation of the scheme of reproduction, or the arrangement of our diagrams.

The thin brown-line prints from the altered negatives of the sectional maps have proven to be of great value, and to effect pronounced economies in the preparation of office records. They serve practically as well as original tracings, and they are to be had on a few hours notice and at small expense. We have used them very successfully as the basis of a set of sewer maps. The sewer lines and all data incident thereto were put on in black drawing ink, and stand out well from the map background. The blue-prints made from these maps are as clean cut in definition as could be reasonably desired. It is anticipated that these thin brown-line maps will be used in the near future for preparing several sets of special function maps of the city, covering such services as water, gas, and electricity.

Field Party Books—An additional use for such a set of city maps may be suggested by the method we employed in making up the map books for the field parties. Heretofore it had been the custom to make these books of small sheets of egg-shell paper, and to a small scale. They were kept in ring binders which fitted the pocket, and so were very convenient. But, each sheet had to be a piece of individual work, was relatively expensive, and when worn out called for a duplication of the original effort to replace it. To eliminate these objections the following method was devised.

The letter size, 8½ in. x 11 in. was adopted as the standard for the field books, and a suitable ring binder as the cover. Two negatives were made of each sectional map and cut into twelve sheets so as to embrace the entire map, with a lap between the adjacent edges of the sheets. The white lines were blacked out for a distance of ½ in. or more from the edge of the sheets, so that the prints would have the appearance of finished an individual workmanship. The negative sheets were cut somewhat larger than the finished print size to provide for printing. The appearance of the prints was good and made into a book they have been very satisfactory. The negative sheets were filed.

High Standard Concrete Roads in North Carolina

Subgrade Checked by Templet—Concrete Mixed a Minute and a Half—Rolling and Belting Follow Machine Finishing

HEAVY reinforcement, a minute-and-a-half mix and an especially careful hand-finish put the new concrete road standards of North Carolina in the van of modern practice. In 1921, the first year of state construction, 16½ miles of concrete pavement were constructed. The present year will probably see this mileage multiplied by ten. Not all of this is of the reinforced section illustrated. With the plain section, however, the thickness is increased about an inch by flattening the bottom of the slab and crowning it to a thickness of 8 in. at the center from 6-in. edges. For a 16-ft. width, the plain slab runs about 2,151 cu.yd. per mile and the reinforced slab about 1,564 cu.yd. per mile. The relative sectional areas are 11 sq.ft. and 8 sq.ft.

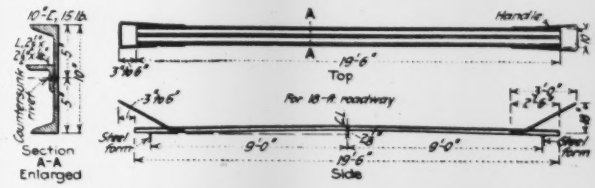


FIG. 2. STEEL SCREED FOR HAND FINISHING

This screed is required to weigh 18 lb. per foot whatever its length and not less than a total of 400 lb. however short. Note that the channel is given an excess crown of ¼-in. to allow for crown slump in rolling, belting and setting.

An unusually heavy reinforcement is being employed and advantage of this is taken, as has been indicated, to reduce the volume of concrete nearly 600 cu.yd. per mile. Both manufactured galvanized steel fabric and fabricated sheets of plain steel bars are employed for main reinforcement. The effective areas and the spacing required in each case are:

	Mesh Fabric	Bar Mat
Main members area per foot, sq.in.	0.172	0.261
Main members spacing, in.	4 to 8	4 to 9
Secondary members, area, per foot, sq.in.	0.033	0.037
Secondary members, spacing, in.	16	16

Both styles of sheet reinforcement are supplemented by marginal bars at the edges and on both sides of all transverse joints. These are bent and lapped as indicated on the plan of reinforcement in Fig. 1. For the heaviest construction indicated the weight of reinforcement runs from 90 to 100 lb. per square. It is placed in flat sheets 2 in. below the surface on a bed of concrete struck off roughly by templet.

A secondary use of steel in the slab is as dowel bars to take shear at transverse joints. These are construction joints exclusively. Wherever the mixer is stopped exceeding 30 min. a joint, as shown by Fig. 1, is installed. The dowel bars are spaced 2 ft. apart, are tarred, painted or otherwise treated to destroy bond, and bond is actually destroyed on one side of the joint by pulling the bar 1½ in. when ready to continue the slab beyond the joint.

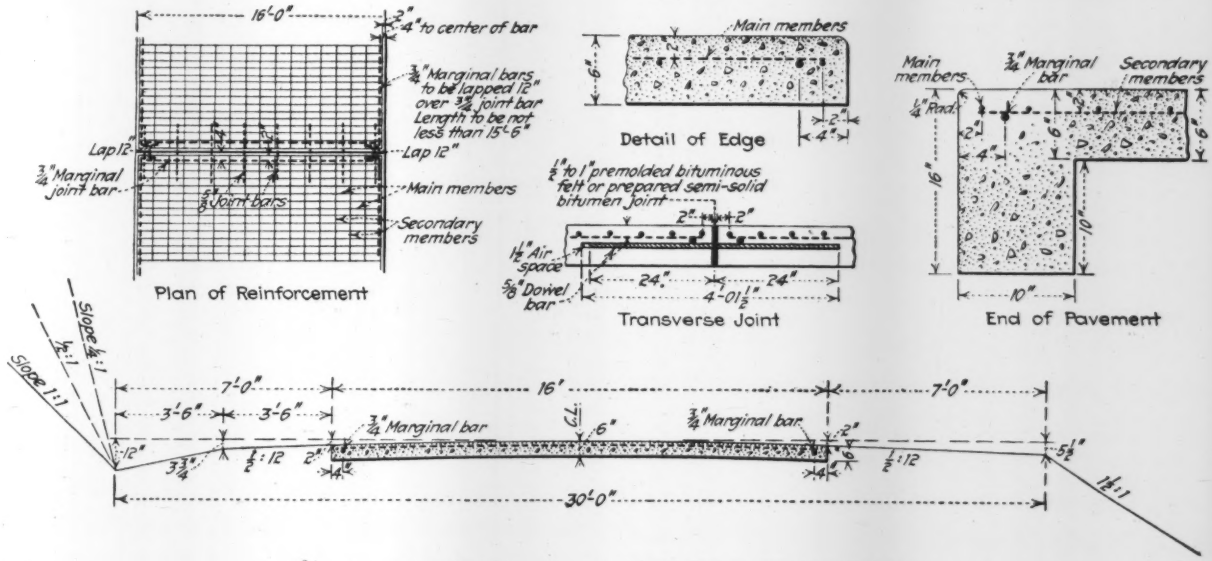


FIG. 1. PAVEMENT SLAB AND REINFORCEMENT DETAILS

Preparation of the concrete mixture is rather closely controlled. The increased use of larger mixers, 21 and 28 cu.ft., both create the necessity and increase the possibility of better preparation of concrete. More precise measuring of material is required because with large mixers the batch containers are of large area and rough charging to mark, introduce variations of

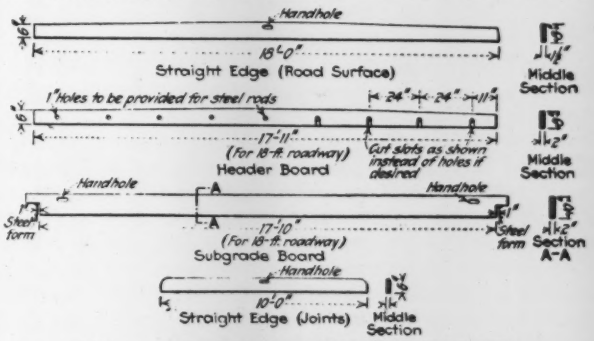


FIG. 3. TEMPLET, HEADER BOARDS AND STRAIGHT EDGES

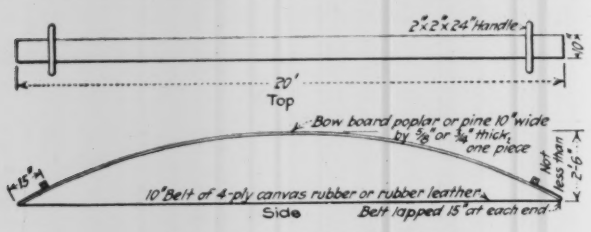

2"x2"x24" Handle
20'
Top
Bow board poplar or pine 10" wide
by 5/8" or 3/4" thick, one piece
Not less than
10" Belt of 4-ply canvas rubber or rubber leather
Side
Belt lapped 15" at each end

FIG. 4. BOW BELT FINISHER
Required length 2 ft. greater than pavement width

considerable volume. On the other hand the large mixer is slower in charging and a longer mixing period is possible without increasing the total time of putting a batch through the mixer. A 1½-min. mix is required after all materials are in the drum. This exceptionally long mixing period is considered not to add materially to the cost of mixing and it is regarded as certainly adding strength to the concrete.

Concrete is placed on a moistened subgrade finished to templet. Either hand or machine finishing is per-

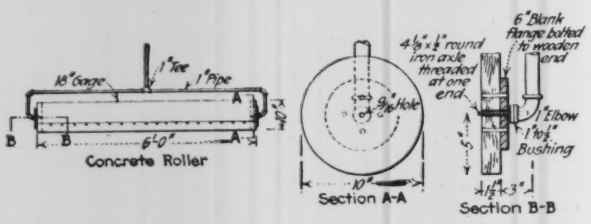


FIG. 5. ROLLER SHEET STEEL ON WOOD ENDS
Weight including handle from 72 to 90 lb.

mitted but in machine finishings rolling and belting by hand are required after the machine has completed its operations. The hand finishing methods are rather precisely stipulated as to both procedure and equipment. Figures 2 and 6 show the standard tools required for hand finishing. The number of templet operations will be noted; subgrade, road surface and smoothness of joints are all determined by templet. In particular the tamping templet, Fig. 2, will be noted for its width and weight. The floats, bow belt and roller are not unusual. Following the belting, burlap covers are spread on the surface and thoroughly wetted. Moisture for curing after set, when the burlap is removed, is provided in any of the familiar ways which the contractor may choose.

The Health Value of City Zoning

In re-writing for the *National Real Estate Journal* of April 10, 1922, his address on "The Health Value of City Zoning" before the recent convention of the American Public Health Association, Charles B. Ball, Chief Sanitary Inspector, Department of Health, Chicago, summarized his discussion in the following five heads: "(1) Less discomfort from smoke, odors, noise, dust and flies, and therefore, to some extent greater vitality and better health. (2) Less crowding of public conveyances and so less contact infection. (3) Less darkness and better air circulation on the street surface, with fewer live pathogenic bacteria in street dust. (4) Less shadow on the dark side of buildings and in the spaces about buildings, which means more light and improved ventilation in rooms. (5) More cheerful outlook from the home and greater cheer within."

Specifications for a Federal Hydraulic Laboratory

By John R. Freeman
Consulting Engineer, Providence, R. I.

Part of the Presidential Address Before the Annual Convention of the American Society of Civil Engineers, Portsmouth, N. H., June 21, 1922.

IMMEDIATELY following my recent inspection of conditions on the lower Mississippi I had a conference with Senator Ransdell, of Louisiana, who for many years past has shown great interest in all pertaining to the improvement of river navigation. I told him about the hydraulic laboratory at the Dresden Engineering School, Germany, and the benefits that might come from a similar structure in America if used understandingly, hand in hand with observations on the river itself; so as to be sure that the eddies and swirls and effects of current in the model were accurately reproducing those of a much larger stream. In order to illustrate more clearly what I have in mind I am having an outline-drawing and details prepared from which to make up an estimate of cost.

The Tilting Tank—In a preliminary way (but subject to revision after conference with others interested) I am proposing a tilting tank for a model river about 250 ft. in length, 20 ft. in width and about 3 ft. in depth, with a broad wing giving a width of perhaps 50 ft. for laying out river bends. This tilting tank should be fixed at one end at a permanent elevation on a fulcrum or pivot and supported elsewhere by a series of jack screws about 25 ft. apart, actuated by worm wheels of varying pitch, proportional to the movement during inclination, so that all can be actuated from a single shaft and motor and the model tank quickly set at any desired gradient from horizontal to say, 3 per cent. After a run at one slope the inclination can be changed in a moment's time by these screws without otherwise disturbing the model. The same apparatus could be quickly adapted for tests on models of jetties for harbor entrances and for studies of shore protection.

Subjects of Study—Within this tank a rough foundation of any convenient material could be shaped up to represent a river channel say 5 to 10 ft. wide by 2.5 ft. deep, or smaller, with the base covered over with earthy material from the river in question. Or, sedimentary material of the kind carried by this particular river could be stirred into the waters as it enters the model channel, and the laws of deposition in eddies behind spur dikes or retards could be studied.

Also, one could study the law of re-distribution of sediments in the bed of a river during floods, by which, doubtless in many critical places during a flood, material is eroded from the pool near the concave shore and deposited along the bar, at the point of contraflexure. One could as well develop further information on the respective merits and disadvantages of straightening a channel that is full of big bends, which topic has been under dispute since Galileo's time. I am strongly inclined to believe that the prevailing authorities are still wrong.

A large amount of much-needed information could be had on the best radius of curvature for the end of spur-dikes placed in series for maintaining a straight-line channel. There can be no doubt that there is an optimum radius of curvature and that a dike, with its end curved downstream on a long radius, can be so formed as to lessen the irregularities of the sand waves in the channel bottom and lessen the tendency to undercut the end of the spur-dike or groin.

Obviously it is far cheaper to begin the development of the best form of groin in a small, cheap model than to build a groin of full size in the river. Moreover, the effect of changes in outline can be far more quickly studied as the experiments progress. One can perhaps cover as wide a range of experiments for finding which is the best form in six days on the model as he could cover in six months on the river.

But studies on the small model and upon the large river

must go on almost simultaneously. The distribution of velocities in eddies, and the capricious forms of sand-waves in river and in model must constantly be compared in order that the tests on the small model may not lead one astray.

Last but not least, is the matter of swirls and eddies and sundry obscure forms of vortex motion in the water, which some of us who have been observing water courses for many years believe are at the bottom of many of the problems of erosion and transportation of sediments. The swirls and eddies of the big river could be studied in parallel with studies in a laboratory of the dimensions proposed.

German Investigations—This tank in the German laboratory managed by Prof. Hubert Engel has been used for a variety of other experiments. For example, studies have been made relative to the shaping up of jetties at harbor entrances on a coastline where the great quantities of sand are swept along by the tidal currents, clogging the entrance to the harbor; and studies have been made of variants in the outline of these jetties, for lessening the deposits, or disposing of them so as to lessen their obstruction to navigation.

Other trials have been made in this laboratory upon the effect of various forms of bulkhead or sea-wall in resisting the action of waves and in obtaining a shape of vertical cross-section of the embankment or sea-wall that will leave the sand carried by waves and littoral currents in good shape. In order to simulate wave-wash on the shore a volume of water is held back by a gate at the upstream end of the tank, which gate is lifted, suddenly allowing a symmetrical wave to advance with uniform speed down the channel and impinge upon the model of sandy fore-shore and bulkhead.

Obviously, this tilting tank could be applied to a variety of other investigations, including an extension of the experiments for determining the laws of flow in drainage pipes, made a few years ago by the U. S. Department of Agriculture. The pipe or conduit to be experimented upon could be blocked up by supports from the bottom of the tilting tank and the water could be run through it at any desired slope, from 0 up to 3 per cent (or even more) by quickly resetting the screw supports. Such a series of experiments would give us much valuable new data on the discharge of partially-filled drains and sewers.

Canal for Stream-Flow Measurements—Alongside this tilting tank-canal I would propose building a parallel canal with concrete walls, say, 250 ft. long, 15 ft. wide, and 15 ft. deep, in which experiments could be made on the flow over models of dams and weirs of various forms, and in which other experiments could be made for determining new methods of precise measurement of velocity disturbed in currents. The current could be given a twist by inclined shear boards attached to the bottom or sides of the tank.

I have had proof that many supposedly accurate measurements by ordinary current meters made in streams having deeply disturbed currents were seriously in error, and the use of such an experimental channel would, I believe, be of great advantage to the hydrographic department of the U. S. Geological Survey and to many other institutions in educating its young men in the avoidance of errors in gaging.

At the end of the second proposed experimental channel provision should be made for some new weir experiments on a large scale, and at greater depths than any heretofore made.

There are numerous problems arising in hydraulic engineering practice, in water development, in municipal water supply, and in the work of the U. S. Geological Survey, the U. S. Reclamation Service, and the U. S. Department of Agriculture, for which such a piece of large-size apparatus of precision would be extremely useful and the results would rapidly repay its cost. When a set of tests has once been worked out understandingly and carefully, the data are unchanging and are within the actual range of experiment, good for all time, like the weir experiments of Francis made 60 years ago.

There never yet have been precise weir tests made with a depth greater than 2.4 ft.; but often we have to compute discharge over dam crests and sluiceways carrying depths of 10 and even 20 ft.

Because of certain preliminary experiments made by the late H. F. Mills at Lowell on a "Venturi flume," the speaker believes a very instructive series could be run on such a piece of apparatus in this new laboratory, which might develop considerable utility in irrigation, flood prevention, or municipal supply.

Hydraulic Jump Experiments—The laws of the so-called "hydraulic jump," which has lately come into prominence as an absorber of energy and thus a safety device for protecting the undermining of dams, could be much better worked out. Through the mathematical investigations of Kennison, reported to this society, we know that the time-honored formula is wrong and the speaker believes that a series of experiments with varying forms of pit and with various forms of deflectors, at the foot of the fall, would aid greatly in showing how best to absorb energy in the friction of eddy currents with maximum structural economy. The absorption of energy at the jump comes chiefly from the friction losses in the violent churning and swirling of the waters in the small open chamber immediately downstream from the jet.

Laboratory for Large-Scale Experiments—This would be essentially a laboratory for experiments on a big scale, leaving to the scores of small scale college laboratories the determinations and researches within their capacity. No college laboratory in America now has, or is likely to have, the capacity needed for experiments required as guides to the hydraulics of the Mississippi.

There are many ways in which such a laboratory can pay back its cost to the country at large, but first and foremost are the many great problems of river hydraulics and river training found along the Mississippi and its many tributaries and in widely separated parts of the United States.

The most difficult matter of all in connection with the establishment of such a laboratory is the finding of the right man for director, a man of inventive genius, born with the spirit of research, and skilled not alone in mathematics, in methods of precise measurement, and in setting traps for errors of observation, but also experienced by months of intimate contact and observation on natural water courses, particularly those carrying much sediment in their varying moods. Such men are extremely rare; only a few appear in a generation. The genius in this line, if found, can make this laboratory tenfold as productive as it would be under a good average scientist or college teacher.

Ten Years of Johns Hopkins Engineer School

In a statement to the governor and general assembly of the State of Maryland on the tenth anniversary of the establishment of the School of Engineering, Johns Hopkins University has reviewed the growth of the school. Beginning in 1912 with twenty-seven students, the enrolment now numbers 313. At the end of the present year the school will have graduated more than 200. Scholarships covering free tuition and text-books have been granted to 439 students from all counties of the state. Evening courses in engineering have been attended by 1,508 students and more than 100 lectures have been delivered by practising engineers. Many important researches have been conducted by the faculty, and professional advice and services have been rendered to seventy-nine industries of the city and state. During the war seven members of the faculty and sixty-two students entered military service and the work of the school was altered to conform to the requirements of the Students Army Training Corps. 1,502 students attended the School of Marine Engineering for the U. S. Shipping Board.

Extension of Fraser River Jetty to Improve Entrance

Problems Presented by Lower Reaches of Third Largest River on Pacific Coast and Efforts to Solve Them

WITH the extension of the Steveston jetty 3,000 ft. downstream, which is now under way, work has been resumed on the improvement of the entrance to the Fraser River. For about 30 years efforts have been directed toward making accessible for deep water navigation the lower reaches of this stream, ranking after the Columbia and the Colorado as the third largest on the Pacific coast. It is hoped that the works now in hand will provide a channel having a depth of from 28 to 30 ft. on a 12-ft. tide.

Characteristics of Stream—The Fraser River is 790 miles long and drains 91,700 sq.mi., all in British Columbia. Its maximum discharge at Hope, 100 miles above its mouth, since 1911 was in July, 1920, and amounted to 380,000 sec.-ft. During the freshet of 1894 the discharge probably amounted to 500,000 sec.-ft. The average maximum discharge is about 300,000 sec.-ft. and the average minimum between 1912 and 1920 was 17,000 sec.-ft., the lowest having been 12,000 sec.-ft. Tributaries that enter the river below Hope have altogether an average maximum discharge of about 56,000 sec.-ft. and an average minimum discharge of about 8,500 sec.-ft. Freshets, which may be expected any time during the months of May, June, and July, are caused mainly by melting snows in the interior of the watershed, over which there falls nearly every year sufficient snow to cause a large freshet if general and prolonged hot weather should prevail early in the season. Extreme low water may be experienced in any month between November and March.

Tidal Influence—The semi-daily tides in the Strait of Georgia, into which the Fraser River empties, are peculiar, the two high waters and the two low waters being unequal in range. Beginning with the higher of the two high waters, the "higher high water," the sequence is first a fall of moderate amount to "higher low water," then a rise of smaller amount to "lower high water," then a fall of considerable amount to "lower low water," followed by a rise through the extreme range of tides to "higher high water," which completes the cycle. The mean rise of tide at the mouth of the river is 12.5 ft. The maximum of the great flood tide is 15 ft., and of the great ebb tide 14 ft., but these maximums are rarely attained. The averages for the great declination tides which occur for a few days twice a month are 12 ft. for the ebb and 13 ft. for the flood. The height of the water surface at mean high tide at New Westminster is 1 ft. lower than at Sand Heads. At "lower high water" it is sometimes a few tenths of a foot lower. During the low water stage the tides affect the river as far as Chilliwack, 67 miles from the mouth, but the current is reversed by flood tide only as far as Fort Langley, 37 miles upstream.

Conditions Affecting Navigation—One of the greatest difficulties in controlling and maintaining the river rises from the fact that it exhibits the leading characteristic of streams that flow through alluvial deposits

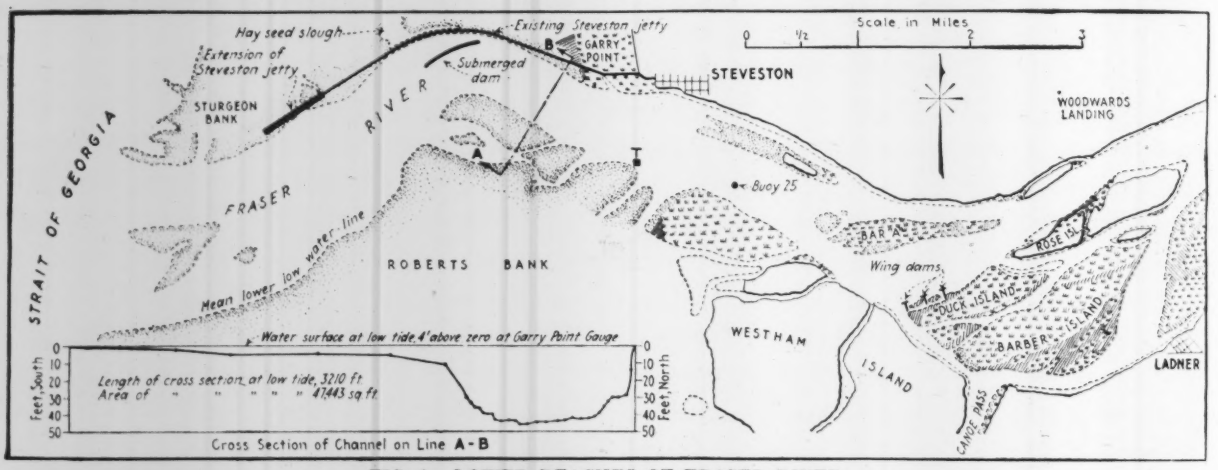


FIG. 1. LOWER REACHES OF FRASER RIVER

The maintenance problems of the lower Fraser River are confined to the sections here shown, the middle section from Woodwards Landing to Garry Point, and the seaward section from Garry Point to the mouth. The problem of the middle section is to protect the banks against erosion and that of the seaward section is to confine the flow to a single channel that will maintain its depth. The "submerged" dam here shown has been removed and a 3,000-ft. extension is now being added to the Steveston Jetty. The design of this extension is shown in Fig. 2.

in that it meanders, eroding its banks on the outer sides of bends, and depositing on the inner sides. The bends, furthermore, move downstream.

The 22-mile reach from New Westminster to the mouth is the most important. This reach may be divided into three sections; the upper of 11 miles, extending from New Westminster to Woodwards Landing the middle section of 5½ miles extending from Woodwards Landing to Garry Point, and the seaward section of 5½ miles extending from Garry Point to the mouth.

The upper section, which is not shown on the accompanying map, Fig. 1, has but one main channel of fairly uniform width, flowing with gentle curves, having many straight stretches, and broken by few islands or bars. Except for about two miles on the south shore below New Westminister, this section of the river is bordered by delta lands which have been diked to exclude flood tidal waters. Throughout its length little difficulty is experienced in maintaining a depth of 18 ft. at low water.

Middle Section—The middle section is divided by many islands and bars which have brought about the formation of several outlet channels. Two of these may

be designated as main channels; the first, or new main channel, to the north of Bar A, and the former main channel between Bar A and Rose and Duck Islands. A third channel passes to the southward by Ladner and Canoe Pass. In the narrower section between Woodwards Landing and the head of Bar A, and along the south shore from the upper wing dam on Duck Island to buoy 25 just above Steveston, the channel is deep. The new north channel is fairly deep in its narrow reaches, but shoals at its lower end.

Changes in the position of the main channel interfere with the maintenance of the river not only because during a transition period the flow is divided between two shallow channels but also because they affect the course of the river below the point of change. The formation of the new main channel illustrates this. The south bank of this channel, against which the current is directed, is being rapidly eroded and the material carried downstream to form bars where the current slackens. A further result of this change is the direction of the current against the bank on the south side of the river below Steveston near platform *T*. This causes the formation of a new outlet channel, which, if it should be widened and deepened, may divert the main flow in the seaward section from its present course. All such places require careful watching in order that corrective measures may be taken in time.

Seaward Section—Throughout the length of the seaward section the banks are of sand, submerged at high tide but largely exposed at low water. Below the Steveston jetty, referred to hereafter, the river widens and divides into two channels separated by a bar. The main channel shifts its position and maintains no great depth of water there being in places less than 18 ft. at low water. Slack water is very marked in this lower reach and is considered to be one of the contributory causes of bars and shoals, its chief effect being to check the movement of material along the bottom. This slack water is accentuated due to the lack of a deep water channel which prevents the sea water from entering the river on the flood until the tide has reached a considerable height. The sea water enters at the bottom of the channel, while the river water covers the sand banks in the seaward part of the delta and is held back by the rise of tide, so that during the freshet and intermediate stages of the river the reversal of current on the flood tide is very much delayed or the river current is merely checked. The river even in its seaward part, has the characteristics of a river and not of an estuary. Hence, it is more important to maintain a single deep channel to facilitate the entrance of the flood tidal water than to provide a wide, open entrance.

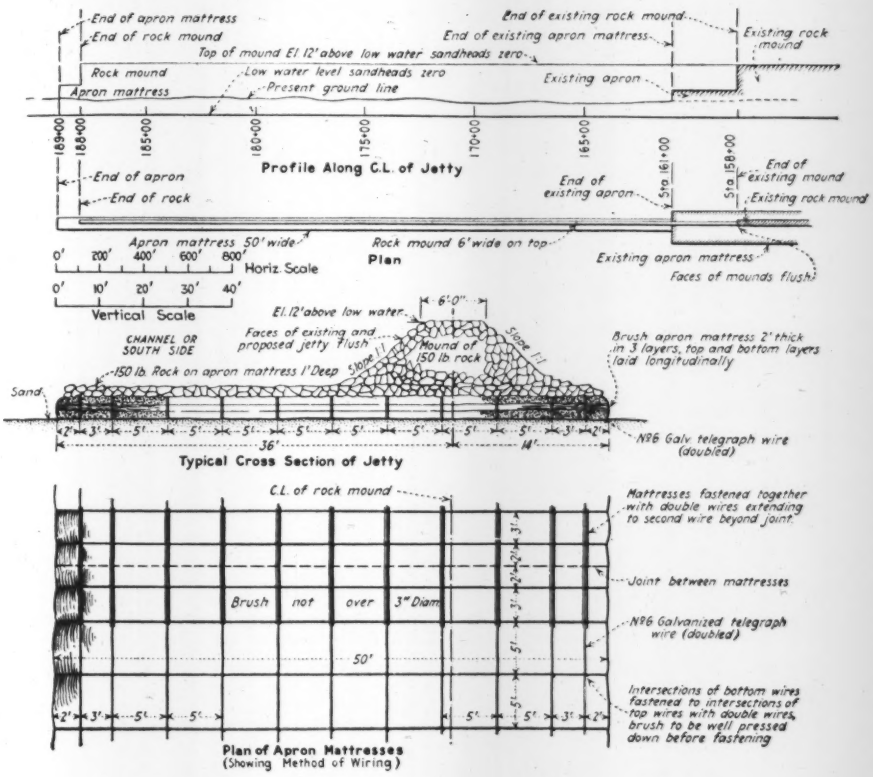

End of apron mattress
End of rock mound
Top of mound El 12' above low water sandheads zero
Rock mound
Apron mattress
Low water level sandheads zero
Present ground line
End of existing rock mound
End of existing apron mattress
Existing rock mound
Existing apron
Profile Along C.L. of Jetty
End of apron
End of rock
End of existing apron
Sta 161+00
Sta 158+00
End of existing mound
Existing rock mound
Apron mattress 50' wide
Rock mound 6' wide on top
Plan
Existing apron mattress
Faces of mounds flush
Horiz. Scale
Vertical Scale
El. 12' above low water
CHANNEL OR SOUTH SIDE
Faces of existing and proposed jetty flush
Mound of 150 lb rock
Brush apron mattress 2" thick in 3 layers, top and bottom layers laid longitudinally
150 lb Rock on apron mattress 1' Deep
Sand
No6 Galv. telegraph wire (doubled)
Typical Cross Section of Jetty
C.L. of rock mound
Mattresses fastened together with double wires extending to second wire beyond joint
Joint between mattresses
Brush not over 3" Diam
No6 Galvanized telegraph wire (doubled)
50'
Intersections of bottom wires fastened to intersections of top wires with double wires, brush to be well pressed down before fastening
Plan of Apron Mattresses
(Showing Method of Wiring)

FIG. 2. DETAILS OF STEVESTON JETTY EXTENSION
Contract was let toward the end of 1921 for this work, which is now in progress.

Improvements were commenced in 1907 when the city of New Westminster obtained a report on the best method of improving the entrance from J. Francis LeBaron. He recommended the construction of parallel jetties or training walls, one-half mile apart, extending from firm land at Garry and Pelly Points to 30-ft. at low water in the Strait of Georgia. These were to have their crests at an elevation of 2 ft. above high water at the shore end, falling gradually to half-tide in a distance of a quarter-mile. The north jetty was to have been 25,700 ft. long and the south jetty 29,500 ft. Mr. LeBaron also recommended certain wing-dams, groins, and bank protection in the upper and middle sections. In view of the cost of carrying out these plans, he was asked for a supplemental report on the application of a single jetty, in reply to which he suggested the construction of a reaction jetty on the north side, extending from just below Steveston. This work was commenced in 1912 with the construction of 3,100 lin.ft. of single bulkhead and 3,800 lin.ft. of double bulkhead with brush mattresses and the necessary over dressing and filling of quarried rock. A second section of the jetty, embodying 7,100 ft. of rock mound on brush mattress, was begun in 1915.

In 1901 there had been built a wing dam, indicated on Fig. 1 as "submerged dam," intended to close off an outlet to the north known as "Hayseed Slough." This dam had not been removed and seemed to interfere with the effectiveness of the new jetty which, however, confined the main flow at low tide to a narrow deep channel from above Garry Point nearly to the dam. Diversity of opinion prevailed as to the line of future work so it

was decided in 1919 to undertake an intensive study of the river and to formulate a definite line of action before proceeding to further expenditure. A board of engineers, consisting of the assistant chief engineer and seven district engineers of the Department of Public Works, was convened and the co-operation of the Federal Department of Mines was obtained. Mr. W. A. Johnston of that department was assisted in his studies by the Water Power Branch of the Department of the Interior, the Hydrographic Surveys, the Department of the Naval Service, the Geodetic Survey, the Precise Leveling Surveys and Triangulations, the Tidal and Current Surveys, and the Geographical Survey.

Recent Improvements—As a result of these studies it was concluded that the old submerged dam blocked part of the channel and prevented deepening of the channel below it. The dam was removed, and the straightening of the channel and the maintenance of an increased and uniform depth appear to have justified the step. Since. 1907 the Department of Public Works had maintained in this locality a Frühling type dredge, which, however, was able only to maintain the existing depth without increasing it. Since the removal of the submerged dam and the consequent proper application of the erosive force of the river, the necessity for maintaining this dredge has been diminished. It was considered advisable, also to resume construction of the Stevestor jetty for a distance of 3,000 ft. as designed by Mr. Le Baron. A contract for this was awarded toward the end of 1921, and the work is now in progress. Fig. 2 shows the general plan and details of this extension.

General Conclusions—With regard to the general situation the investigating committee reached the conclusion that the material carried in suspension by the river is not of great effect in shoaling the main channel except at the mouth, to which most of the suspended matter is carried. Bars are formed instead by the material moved along the bottom, which is of maximum volume when a shifting of the main channel is taking place. The problem of the middle section, therefore, is to prevent the shifting of the main channel.

In any scheme to effect permanent improvement the committee believes that effective bank protection must be an essential. This however, is complicated by the fact that the upper silty beds are more resistant to erosion than the underlying beds of sand. When erosion is active the underwater face tends to become nearly vertical with depth up to 80 ft. close in to the bank. This exposes the sandy lower strata which are washed away, thereby undermining the upper banks. Considerable sums have been expended in bank protection by the Department of Public Works but with indifferent success due to the difficulty of protecting the underwater faces of the bank.

The investigations indicate that until the river can be confined to its channel by protecting the banks on the outside of bends, protection works in the seaward section are likely to prove of little value. The problem of finding an effective means of bank protection that will be permanent and not prohibitive in cost applies, therefore, to both the middle and seaward sections.

The information in this article has been obtained largely from J. Francis LeBaron, consulting engineer, from K. M. Cameron, assistant chief engineer of the Department of Public Works, through the courtesy of A. St. Laurent, chief engineer of the Department, and from Memoir No. 125 of the Canada Department of Mines on the "Sedimentation of the Fraser River Delta," by W. A. Johnston. In this memoir are contained complete technical data concerning the river, its geology, tidal characteristics, climatic conditions on the water sheds, currents induced by variation in density, wind, and tide, sediment transported, and other characteristics.

Research as Important as Instruction in University Work

AT THE annual meeting of the Western Society of Engineers, C. R. Richards, for several years dean and director of the College of Engineering, University of Illinois, and now president of Lehigh University, laid down the principle that scientific research should be given a standing equal to that of instruction in the aims of the modern university. What follows is an abstract of President Richards' expression on the subject.

Research and Instruction—It should be the purpose of real universities to place scientific research and the advancement of knowledge in a position of equal importance with the work of instruction. The tremendous development of technical education during the past fifty years, with the constantly increasing number of technically educated men in industrial life, has increased the need for more exact information concerning the scientific basis of industrial activities, and demands that those responsible for the advancement of these activities utilize more effectively the results of technological research. Whatever may be the future of technological research in the universities as compared with that in private laboratories, the fact remains that educational institutions have blazed the way and have made the importance of such research fully apparent.

Until recently, comparatively few of the engineering industries have appreciated the value of scientific research. Now, most of them are alive to its importance and many of them have undertaken its promotion by one means or another. It is difficult to determine when a corporation or an association of concerns having a community of interests, can justify the organization of an independent research laboratory. The great expense of operation, the difficulty of securing men competent to do research work, and in many cases the failure to recognize the nature of the problems to be solved, are likely to bring many of these commercial laboratories, as well as research in general, into disrepute. A commercial organization which is forced to show suitable profits to its stockholders may have difficulty in properly evaluating the work of its own laboratories.

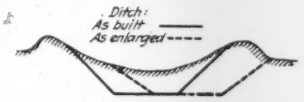
It is probable that the solution of the problems of most industries can best and most economically be undertaken through association with the universities and technical schools. Emphasis should be given to the fact that ordinarily such co-operative arrangements are entered into with no expectation of profit and that a well-equipped institution has scientific facilities both in apparatus and men which cannot readily be duplicated in any private laboratory. Thus, in the field of engineering research as conducted in a modern university the scientific workers have advantages through association with the professors in physics, chemistry, bacteriology and other branches of pure science which may have a direct bearing upon engineering investigations in progress. Many leaders of industry have looked upon men engaged in academic pursuits with some contempt, but this attitude is rapidly changing. In an ever-increasing degree the industries of the country are looking to the technical schools for assistance, and are co-operating with them to their own advantage as well as to the advantage and advancement of education and knowledge.

Enlarging Old Drainage Ditches in Missouri

Widen Ditch by New Side Cut, as Unstable Subsoil Causes Slips in Deepening—Draglines Preferred to Dredges

IN ENLARGING and clearing out about 32 miles of ditches in drainage districts Nos. 12 and 14 of Scott County, Mo., trouble was experienced from sliding soil which made it necessary to provide the increased flow capacity by widening instead of deepening. These ditches have a bottom width of 10 to 20 ft. and a depth of 5 to 12 ft. As excavated originally the slopes were left at about 1 on 1, but they had gradually settled and became approximately 1 on 2.

It was planned to carry out this work by removing the sediment and slipped material and to excavate the bottom to 4 or 6 ft. below the original grade line, leaving the slopes undisturbed. The idea in this was that the banks or slopes of the ditches seemed to have become stabilized through duration of time, and that by taking all the excavation from the bottom of the ditch the banks or sides could be prevented from sliding and caving. It was found, however, in the construction of the work, that the subsoil is underlaid with quicksand or sand of a more or less saturated nature, so that when the earth was removed from the bottom of the ditches the only means of support of the slopes or banks was removed. When an excavation of 4 to 6 ft. was made in the bottom of the ditches the sand would begin to run in to the center of the ditch from underneath the berm or waste banks, with the result that the entire slope and bank of the ditch would gradually settle into the ditch. Under this condition, after any one section of the work was completed the bottom of the ditch was comparatively little lower than when construction started.



SECTION OF CLEARED AND WIDENED DITCH

To secure permanent results it has been found expedient to use a point near the center of the ditch for the outside edge of one of the slopes, as shown in the accompanying section. Particular care was taken not to get near the bank of the ditch. All excavation was made on one side, entirely removing one berm and waste bank, and by making a flat slope (about 1 on 2 or 2½) on this side, it has been found that the banks cave very little. This method increases the yardage of the work considerably beyond what was originally contemplated, but results in a ditch which stands up fairly well. The cost of the work is of course increased in the amount of the increased yardage of excavation, but it is felt that the extra expense is a good investment, for it is the only method found for maintaining the ditch in proper condition. Another case of widening drainage ditches and providing flat slopes, also in Missouri, was noted in *Engineering News-Record* of Aug. 11, 1921, p. 227.

Dragline excavators are being used in the Scott County work and are giving satisfactory results. Starting at the outlet end of the ditch, they give immediate relief to the adjacent lands for the reason that they dig upstream rather than downstream, as is necessarily done with the floating type of dredging machinery. Moreover, it is considered that there would have been considerably more trouble with floating dredges in this particular work, or the reason that dams would have to be maintained to hold sufficient water for the dredges to operate. When the ditch was completed to its outlet or past the dam, the water would go out with a rush, and as the banks of the ditch would be thoroughly saturated with water standing against them for a comparatively long time they would be liable to cave more severely than they do under the present plan. This condition might not be true in certain other kinds of soil. In fact it is considered evident that every contract or problem in such work needs its own design and that no standard can be determined in advance for all classes of construction work in drainage or land reclamation.

This improvement is being made under the direction of C. E. Swank, Charleston, Mo., chief engineer for the drainage districts in question. The W. E. Callahan Construction Co., Dallas, Tex., has the contract, and the cost will be about $175,000. Work was commenced in the fall of 1921 and is expected to be completed by December, 1922.

Corrugated Culvert Pipe Jacked Through Embankment

By P. F. Jones
Chief Engineer, Modesto Irrigation District, Modesto, Cal.

CONFRONTED last winter with the problem of carrying the south branch of the Davis-O'Connor Drain underneath paved highway and the main line tracks of the Southern Pacific R.R. at Salida, Cal., a corrugated culvert pipe was used like a tunnel shield. A siphon was necessary, with its bottom grade 9 ft. below the surface

JACKING CULVERT-PIPE THROUGH AN EMBANKMENT

of the ground. It was wholly impracticable to interrupt traffic to excavate and, even if it had not been, the expense would have been very heavy. It was therefore determined to jack a corrugated pipe through the fills.

A siphon which carries water under railroad tracks must, of course, be water-tight. Corrugated pipe can readily be made tight by close riveting and soldering and this is the method usually employed. But it was

decided that in this instance soldering was not practicable on account of the likelihood of the solder being loosened by the jacking operations. The final decision was to install a concrete pipe, in 2 ft. lengths, inside the corrugated culvert. This could readily be made watertight by means of cemented joints; and the corrugated pipe would act as a jacket and afford ample protection against the jars and strains of traffic.

Armco corrugated No. 19 gage was purchased. This was delivered in three 30 ft. sections, one 24 ft. section and two 16 ft. sections. The joints were expanded, joined and riveted in the trench. Only two sections of the pipe had to be jacked—one of 30 ft. under the railroad tracks and one of 24 ft. jacked under the highway paving. The remainder of the pipe was laid in an open trench.

The equipment used was an ordinary screw jack; timber backing to take the thrust of the jack; a bilge pump to keep the trench drained, and a rope and box for removing earth from inside the pipe as it went forward. This box was 16 x 16 x 14 in. The soil was removed by hand, a workman operating inside the pipe. Owing to the confined space, laborers would change off approximately every hour.

The installation occupied four men for twelve days actual working time. The sections under the highway and railroad were jacked forward at the rate of 1 ft per hour. The soil encountered was quicksand for approximately 30 per cent of the distance, and clay pan for the remainder. Water stood 3 ft. above the bottom of the trench, requiring the use of the bilge pump. The driving end of the culvert was not protected in any way; and its condition at the end of the job was perfect.

The total cost of the siphon, including labor, pipe, supplies, etc., was $1,243. It seems that this form of installation might be employed to advantage in many locations. Not only water pipes but those for gas or oil may readily be carried under railroad embankments in this manner. Costly and more or less dangerous operations are avoided and the whole operation is carried on without interruption to traffic.

Steamship Dock and Warehouse at Milwaukee, Wis.

Concrete Structure with 440-Ft. Dock—Waterproof Basement—Ramps with Inclined Floor—Conveyors Assist Trucking

AN EXAMPLE of modern steamship terminal facilities at ports on the Great Lakes is a new dock and warehouse of reinforced-concrete construction built at Milwaukee, Wis., for the Milwaukee Terminal Co. This four-story structure 440 x 122 ft., with 440 ft. frontage on the Milwaukee River and on Erie St., adjacent to the Broadway bridge, has its first floor designed for use as a steamer wharf and freight shed. The basement is for freight storage and the upper floors are for warehouse and light manufacturing purposes. A view of the river elevation is shown in Fig. 1.

FIG. 1. DOCK AND WAREHOUSE ON THE MILWAUKEE RIVER

Along the river front of the building is a 3-ft. dock wall having its top 7 ft. above the water level. But this wall is not level with the floor of the building, being intended mainly for use in mooring steamers. As shown by the typical section, Fig. 2, the basement floor is 4 ft. 9 in. above the water and 2 ft. 3 in. below the dock wall. The first floor is 3 ft. 6 in. above the street level, so that it is convenient for handling goods to and from wagons as at a freighthouse.

Passenger facilities arranged across one end of the first floor include ticket office and waiting rooms, with a stairway leading down to the dock wall, from which a gangway is laid to the steamer deck. Freight movement is facilitated by five concrete inclines or ramps from the first floor to the dock wall. These ramps are 15 ft. wide and in the middle of each one is a motor-driven conveyor or traveling platform on which the truckers ride with their hand trucks. A similar ramp leads up from the basement to the dock wall.

Concrete footings on wood piles in a heavy clay formation constitute the foundation. The dock wall is built on two rows of round piling with a line of triple-lap wood sheeting behind the first row, as shown in Fig. 3. This timber bulkhead is held in position by tie-rods at-

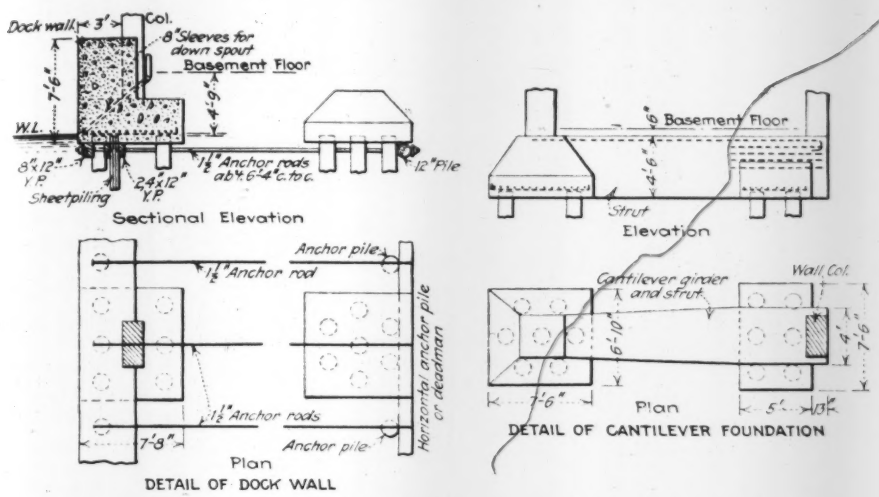


FIG. 3. DOCK WALL AND CANTILEVER FOUNDATION GIRDERS

tached to horizontal deadmen placed behind anchor piles in the rear of the first interior row of footings. At the north end of the building, where the footings are kept within the property line, the wall columns are carried by cantilever girders extending over two rows of footings, as shown. These cantilevers also form struts to resist lateral thrust.

A dry basement was essential for freight storage. To secure watertight construction, a cinder fill was placed between the clay and the concrete floor and an integral waterproofing compound was added to the concrete for the basement floor and dock wall. The result is reported to be entirely satisfactory.

Flat-slab floor and roof construction is used, supported by circular columns forming panels 21 x 21 ft. The first floor is designed for a live-load of 250 lb. per square foot and the others are designed for a 200-lb. load. Cement finish is applied to the floor slabs, except that wood paving is used on the first floor. Brick curtain walls have a large area of steel sash with wire glass. On the street side of the first floor are a number of freight doorways 12 ft. wide and 10 ft. high, fitted with rolling steel doors. Similar doors are used at the openings along the dock wall. Three 8-ton freight elevators are provided. Sprinkler fire protection equipment is served by a 40,000-gal. capacity steel tank and tower situated above the roof.

This marine terminal and warehouse was designed by Albert S. Hecht, architect, with Lieberman & Hein as structural engineers. It was built by the Thompson-Starrett Co. All these are Chicago firms.

Milwaukee County to Build Main Sewer System

Formation of a Metropolitan Sewerage Commission for Milwaukee County, Wis., late in 1921, for the area outside of the city of Milwaukee, linked up the political areas which are one topographically. Outside districts can now be handled in conjunction with the extensive improvements of the Milwaukee Sewerage Commission in cleaning up the drainage areas of the Milwaukee River and its tributaries. Both bodies are state commissions and the plans are being worked out to handle county sewage by intercepters connecting with the city system. For the year 1922, $1,300,000 in bonds has been authorized by the county board of supervisors for the Metropolitan Sewerage Commission. The budget planned includes two main intercepters; one for Whitefish Bay and Sherwood and the other for a section north of the city and North Milwaukee, which is to be connected with the city's West Side intercepter.

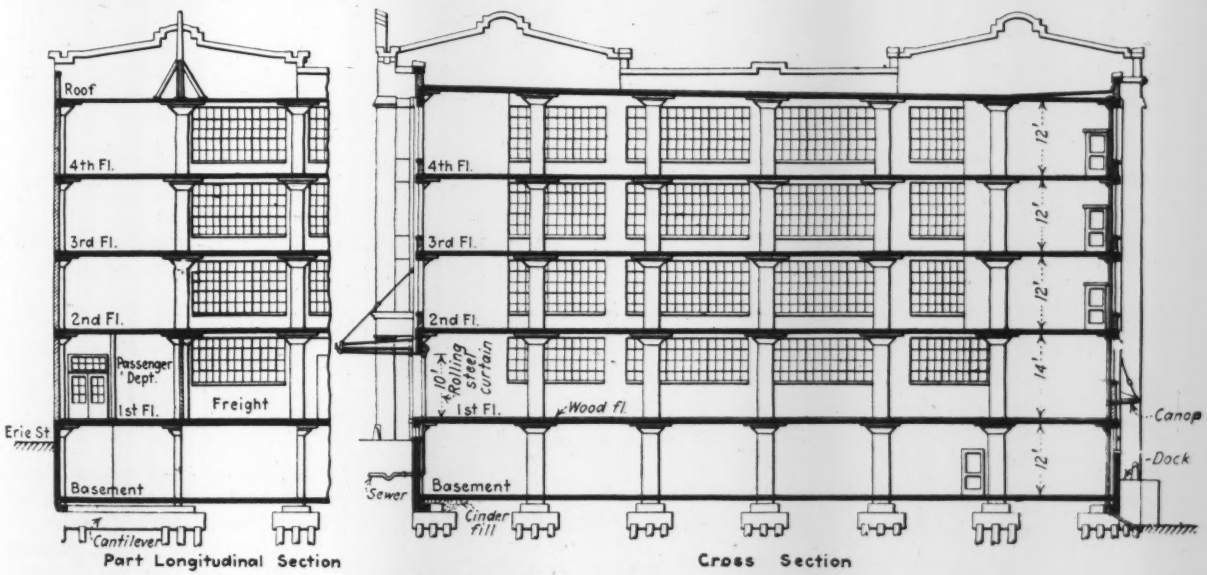


FIG. 2. CROSS-SECTION OF DOCK AND WAREHOUSE BUILDING

Large Activated-Sludge Plant for Chicago Sanitary District

To Serve 800,000 Population in 1930—Bar Screens, Grit Chamber, Fine Screens, Dorr Thickeners—Sludge Lagoons for First Use

AN ACTIVATED-SLUDGE plant with sludge disposal by pumping to lagoon was recommended on Feb. 27 for the north-side sewage-works project of the Sanitary District of Chicago by a commission of engineers consisting of Harrison P. Eddy, Boston, George W. Fuller, New York City, and T. Chalkley Hatton, Milwaukee, Wis. The plan was approved by the Board of Trustees of the Sanitary District on May 18 and orders to prepare detailed plans and specifications in accordance with the report of the engineers were issued to Albert W. Dilling, chief engineer of the district. This will be the third and much the largest activated-sludge plant built by the Chicago Sanitary District, two others now being near completion, known as the Calumet and Des Plaines, (see *Engineering News-Record*, Dec. 9, 1920, p. 1134, and June 9, 1921, p. 986). For the present only part of the Calumet plant will make use of the activated-sludge process. The area tributary to the north-side works extends from Glencoe on the north to Fullerton Ave. at the south. The estimates assume a population of 800,000 in 1930 and an average sewage flow of 175 m.g.d.—mostly from confined sewers receiving but little industrial waste. The 1920 population was about 600,000. The effluent will reach the main drainage channel via the North Shore Channel and the North Branch of the Chicago River. The proposed site for the works is 177 acres of land owned by the district in Niles Township, just west of the North Shore Channel.

Cost estimates (see table) were made for (1) coarse screens, grit chambers, Imhoff tanks, fine screens, trickling filters and humus tanks, with sludge beds and final sludge disposal by barging the sludge to fill low ground near the Main Drainage Channel west of the city; (2) activated-sludge works, with coarse screens, grit chamber, fine screens, aeration tanks, Dorr thickeners in the settling tanks, dewatering plant to convert the sludge into 10 per cent moisture commercial fertilizer base at the works, with no credit for the dried sludge on account of uncertainties as to dewatering and marketing it; (3) activated-sludge works as in (2) but with the liquid sludge pumped to lagoons on land owned by the district near the Main Drainage Channel west of the city. At this site a central sludge dewatering and drying plant to serve several other sewage-works could be built if warranted in the future. Consideration was given, but without making cost estimates, to fine screening, sedimentation, chemical precipitation, "direct-oxidation" (lime-electrolytic), sand filtration and contact beds.

The Imhoff-tank sprinkling-filter project was dismissed because it was thought that an activated-sludge plant would be freer from objectionable conditions, even after allowing for (1) 1,500 acres of extra land (gross area 1,700 acres) to isolate the sprinkling filters by means of a strip of land one-half mile wide, and (2) for 70 acres of sprinkling filters so one-seventh of the area might be periodically flooded and out of use in summer to prevent the small-fly nuisance.

The Imhoff tanks provide for 2¾ hours detention and 2.3 cu.ft. per capita of sludge storage. The trickling filters are of broken stone 6½ ft. deep and are designed to receive sewage at the rate of 3 m.g.d. per acre or 0.462 m.g.d. per acre-foot of stone. This gives a gross loading of 11,430 persons per acre or 1,750 per acre-foot of stone. Allowing for 10 of the 70 acres out of service for flooding during the fly-breeding season, the net loading rate is 13,330 persons per acre and 2,050 per acre-foot. The humus tanks are of the one-story hopper-bottom type, with an average detention period above the hoppers of one hour. For the digestion of the humus-tank sludge, an Imhoff type of tank is provided. Sludge-drying beds of a net area of 14 acres are included, or 0.75 sq.ft. per capita. The filter isolation area of some 1,500 acres area adds $2,250,000 to the cost of this project, land in each case being figured at $1,500 per acre. The isolation area requires a short extra length of sewer construction, compared with the activated-sludge estimate.

COMPARATIVE ESTIMATES OF COST OF NORTH-SIDE SEWAGE WORKS

CHICAGO SANITARY DISTRICT

Based on 175 m.g.d. average and 263 m.g.d. maximum sewage flow or 220 and 330 g.d. per capita.

		First Cost*	Capital Charges†	Renewals and Repairs	Power, Labor & Supplies	Total Annual Cost
(1)	Imhoff tanks-trickling filters..	$16,433,500‡	$1,105,020	$152,982	$510,440	$1,778,442
	Per m.g.d.....	93,900 (p.m.g.)	17.46	2.40	8.00	27.86
(2)	Activated sludge, with dewatering.	14,502,713**	983,716	266,456	946,277	2,196,449
	Per m.g.d.....	82,872 (p.m.g.)	15.40	4.16	14.81	34.38
(3)	Activated sludge, with lagooning..	13,203,321††	895,579	205,451	630,660	1,731,690
		75,447 (p.m.g.)	14.02	3.22	9.87	27.11

* Common to all three projects are coarse screens, pumping plants (with 57-ft. lift for (1) and 53-ft. lift for (2) and (3); grit chambers and fine screens. In (1) the fine screens are placed between the Imhoff tanks and trickling filters and are much less expensive than the 8 Rex screens, each 7 x 53 ft., at $30,000 each to be placed between the grit chambers and aerating tanks in (2) amd (3). In each case 15 per cent is allowed for engineering and contingencies.

† Interest at 5 per cent and annual charge of 1.783 per cent to redeem bonds in 30 years on 4 per cent sinking fund basis.

‡ Includes heavy allowances on account of "isolation strip" ½ mile wide around plant to prevent complaints of odors from spraying sewage on trickling filters. This strip adds about 1,500 acres to the 187 acres otherwise allowed for site for this project and for projects (2) and (3); or at $1,500 an acre, a total of $2,250,000 extra for land. Besides this, $272,000 net is added for extra sewer construction. Project (1) also includes $500,000 for sludge barges, etc.

** The total first cost of the dewatering plant is $2,190,635, divided as follows: 50 Berrigan presses, including pumps, pipe, etc., $750,000; 6 rotary dryers, $300,000; conveyors, grinders, shakers, bagging equipment, etc., $62,000; buildings, $714,200; coal and ash handling equipment, $78,700; engineering, etc., $285,735.

†† First cost of sludge disposal by pumping and lagooning totals $891,250, thus divided: sludge force pump, $5,750; 12-in. cast-iron force main about 18 miles long, $655,500; lagoons $230,000. Estimates of first capital and pumping costs for 16-, 12-, 10- and 8-in. pipe lines showed that the 12-in. was considerably the cheapest.

(All foot notes compiled from the many detailed tables and the text of the report.—EDITOR.)

In the activated-sludge estimates the aeration tanks are 15 ft. deep and have a capacity 20 per cent in excess of that required for six hours detention at the average rate of flow; or in other words, provision is made for a 20 per cent sludge return. The air rate is 1¼ cu.ft. per gallon. Filtros plates on a 4 to 1 ratio are provided for. The settling tanks are 15 ft. deep, with 1 sq.ft. of surface per 1,600 gal. of sewage in 24 hours at the maximum rate of flow, but with no allowance for sludge deposits.

The sludge dewatering estimates assume a final 10 per cent of moisture. They include sulphuric acid treatment, Berrigan presses, rotary dryers (washing the dryer gases to remove dust) grinders, sieves, conveyors and final bagging. It is estimated that each 1,000,000 gal. of sewage would produce 1,000 lb. of dried sludge.

A Review of Recent Accidents in New York Subways

Delays Due to Excess Runoff from Streets, Broken Water Mains, and Short Circuits in Trains and Power Houses

By Robert Ridgway
Chief Engineer, New York Transit Commission

In order that engineers may have authoritative technical information concerning the series of accidents that have recently befallen the New York rapid transit subways, Mr. Ridgway has prepared, at our request, the following statement as to the scope of the difficulties and their causes, so far as it has been possible to determine them.—Editor.

BEGINNING about a month ago, a series of accidents occurred in connection with rapid-transit operation in New York, in some cases causing partial or complete suspension on a line or system, with consequent delay and inconvenience to passengers. Such a series of delays, occurring at so frequent intervals, and being detailed and dilated upon by the daily press, may cause some apprehension in the minds of the traveling public as to the efficiency and safety of the rapid-transit systems upon which they are dependent. It is proposed, therefore, to consider in some detail the nature and causes of these several accidents. They may be grouped into two general classes: those caused by water and those by fire.

Delays Caused by Water—Considering the first class, on July 1, train service on the Interborough subway on Seventh Ave. was delayed near Houston St. by water to a height of about 12 in. above the tracks, which caused a suspension of through operation on that line from about noon to 2:20 p.m. On the same day traffic was interrupted in the Eastern Parkway (Brooklyn) line of the Interborough subway between New York and Troy Aves., from 12:56 to 2:30 p.m., by water over the subway tracks. On the same day also service on the Fourth Ave. subway line of the New York Municipal Ry. Corp., in Brooklyn was interrupted because of the collection of water over the tracks of the subway near Union St.; and a similar suspension of traffic occurred on the Brighton Beach line because of water over the tracks near Newkirk Ave.

These several suspensions of traffic all were due to the excessive rainfall of that day, which was reported to have exceeded 1½ in. in two hours and more than 1 in. in twenty-five minutes. So excessive a rainfall overtaxed the catchbasins and sewers to the extent that at certain locations the water on the street surface rose above the level of the curbs. At Union St., Brooklyn, the water on the surface is stated to have stood two feet above the street surface.

In the cases of Seventh Ave. near West Houston St., Eastern Parkway, between New York and Troy Aves., and Fourth Ave. near Union St., the water rising above the curbs was diverted into the subway through the openings and gratings provided in sidewalks and parkways for ventilating the subway trainways, and thence along the tracks to the lowest points adjacent. At each of the locations mentioned drainage sumps, equipped with automatic pumps, were provided at the time the subway was constructed. The capacities of the pumps were based upon ample allowance for the flow likely to reach them from outside seepage and from sources within the structure but not upon so excessive an inflow from the street surface as was caused by the storm water rising above the street curbs. The pumps are arranged to work automatically, and did so; but they were unable to cope with the large inflow.

The tracks of the Brighton Beach line, at Newkirk Ave. were flooded by the obstruction of a cross drain which was under pressure during the flood. The water flowed off by gravity when the pressure was released.

On the evening of July 18, the Seventh Ave. line of the Interborough Co. was again flooded near Houston St., at the same point and from the same cause as on July 1, causing a suspension of through operation from 7:57 to 10:30 p.m. The rainfall again flooded the streets and entered the subway through the gratings in the sidewalk in the block north of Houston St. Investigation of the conditions in the vicinity would seem to indicate that a contributing cause was the temporary condition of the sewers due to the reconstruction of a large sewer in Clarkson St., which had been made necessary by its insufficient capacity.

On July 26, service on the Lexington Ave. line of the Interborough Co. was slightly delayed in the early morning by water entering the subway near 26th St. through the west wall of the subway. This flood was due to the breaking of a 36-in. water main running east and west on the north side of 26th St. The water rose to the top of the rails only and did not stop traffic.

On July 29 a 12-in. water main broke at the southwest corner of Flatbush and Fourth Aves., Brooklyn. The resulting flood did not interfere with subway operation. Near the point where this main broke there was a duct manhole which was damaged and in process of reconstruction when, on Aug. 4, another break occurred in a 16-in. main near that point. The water from this break found its way through the holes of the duct line and discharged into a duct manhole located inside the subway near Atlantic Ave. station. A 4-in. brick curtain wall separating the tracks from the splicing chamber was not of sufficient strength to resist the water pressure. When it failed the water flowed to the tracks to a depth of 20 in., causing a suspension of traffic on the Interborough lines east of Atlantic Ave. station from 8:50 p.m. to 12:30 a.m. The pumps provided at the sump nearby worked automatically and removed the water as soon as the inflow was controlled.

In the case of each delay or suspension of operation mentioned thus far, the reason for the delay or suspension originated entirely outside the subway structure and from causes beyond the control of the operating companies. There is nothing indicating laxity on the part of the operating companies, either in the matter of prevention of the occurrence or resumption of operation. The permanent equipment provided for the removal of water was adequate for the contemplated needs, and worked automatically as intended. Auxiliary emergency pumping equipment on cars was brought in and operated when it proved of advantage to do so. The water in each case entered the subway through necessary openings provided for proper ventilation or for other purposes. Heavier rainfalls of longer duration have occurred without affecting subway operation at these points and it is not clear why the runoff

through the streets and sewers was not so efficient as it had been in the past. The delays of this class did not cause any danger whatever to the traveling public.

Delays Caused by Fire.—Considering the second cause of delays and suspension of traffic we find two cases. On July 6 a short circuit occurred on the switchboard or panel box of the fifth car of a northbound Jerome Ave. express train in the Lexington Ave. subway of the Interborough Co. near 60th St., which required the shutting off of power and suspension of traffic between Grand Central and 77th St. stations from 11:13 a.m. to 1:03 p.m. Because of the consequences that followed, this accident is the most important of those yet mentioned. The short circuit set fire to the insulation contained within the panel box and the paint and varnish of the vestibule of the car adjacent, generating a large amount of smoke and fumes. The draft of air from the ventilation of the subway carried the smoke toward the north and, as the train had been brought to a stop, most of the passengers from the train walked south, along the footwalk provided for that purpose on each side of the tracks, to the emergency exit at 59th St. The passengers from a southbound train stopped by the shutting off of power in the affected section just north of the one with the short circuit, also walked south through the smoke to the exits at 62nd and 59th Sts.

It is probable that 150 passengers were aboard the train on which the short circuit occurred, and that from fifty to seventy persons were more or less affected by excitement, smoke and fumes, and by the unusual exertion of climbing 60 ft. of stairway, the express tracks at this point being at quite a depth beneath the street. There were no fatalities. All, with the exception of some of the trainmen who remained to care for the train, went to the street above. Some received assistance up the steps, nine were reported to have fainted or lost consciousness after reaching the street, and sixty-seven were sent to the hospitals for treatment. All but thirteen of these were discharged on the day of admission. In all, 112 persons received medical treatment. It was at first thought that the condition of those treated might be due to the use of pyrene fire extinguishers. The record of the case of each patient treated indicates that this was not a fact, and that, except in the cases of four or five of those treated, in which the pyrene fumes appear to have aggravated the smoke effects, the symptoms could all be accounted for by the known effects that result from the burning of insulating materials, rubber, varnish and paint. It is apparent, therefore, that most of the passengers were suffering from panic, and the remainder, with the exceptions noted, wholly from smoke and fumes. The trainmen who remained with their trains were not affected.

The panel board of the car in which the short circuit occurred is a small switchboard on which is installed the electrical apparatus, such as switches, relays and fuses, by means of which the current for motors, lights, heaters and air compressors is controlled. These instruments are mounted on a slab of slate and are covered by a steel door lined with asbestos. All of the wires connecting with the instruments on the panel board are rubber-insulated and are carried to the panel in iron conduits, the insulation of the wires being the only inflammable material on or near the panel board. It is difficult to understand how such a destructive arc originated, and there is no precedent to guide in this case. It is reported that in the seventeen years since the beginning of subway operation, no other accident of this nature has occurred. The routine of the operating company requires that the entire equipment of each car be inspected after each 1,000 miles operated. This particular car was last inspected on July 3, 1922, since which date it had been operated only 323 miles.

Determination of the precise cause of the short circuit has been made difficult as the result of the destruction produced by so intense an arc. The occurrence has been carefully investigated and steps are being taken to avoid a recurrence.

On July 25 there was a complete suspension of traffic on the lines of the Brooklyn Rapid Transit Co. as a result of a fire in the Williamsburg power station of that company. The fire occurred at the rush hour of the day and consequently caused greater inconvenience to the traveling public than all the others mentioned. Trains and surface cars were stalled at various points over the system, beginning at about 5:15 p.m., and full service was not resumed until about 8:55 p.m. This fire also was due to a short circuit and originated on an oil-switch connected with a generator, the switch being so badly damaged that the exact cause could not be determined. The intensity of the arc that was formed caused fire at other points and to combat the flames it was necessary to shut off all power. Except for the delay and inconvenience caused the traveling public, the latter would probably have been unaware of the occurrence of the fire. It had no bearing on the question of safety to passengers, except that of possible panic, as a result of trains being stalled indefinitely in the tubes at a time when the Lexington Ave. fire was still fresh in the public mind. The absence of panic under the unusual and trying conditions speaks well for the mental balance of the passengers.

Summary—In the foregoing review of the various delays to rapid transit traffic and their causes, two facts are apparent. First: Without a single exception the accidents were of a most unusual nature and therefore difficult to provide against. The delays from flood were due either to the failure of the street and sewer drainage system to carry off the excessive rainfalls, or to the bursting of water mains. Consequently, when the water rose above the level of the curbs, it found its way to the subway through the stairways, ventilation and other openings provided for various purposes. When the trainways are so flooded it is not reasonable to expect that the water can be removed immediately by pumping into the streets or sewers at a time when the latter may already be choked and flowing under a head. Second: In but one of the cases mentioned was there any real exposure of the passengers to danger, and in that case it appears that the danger was, at least in part, within their own control; for it is certain that more of the passengers suffered from panic than from any injurious effects resulting from the fire itself. Such accidents as the Lexington Ave. fire reflect credit upon the manner with which the train crews and employees of the operating companies have taken care of the directions for safeguarding the passengers in such emergencies. In comparison with the car mileage operated it may be stated that since the year 1917 and including the present year the occurrence of short circuits has been gradually reduced in number.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Simple Remedy

Sir—In an editorial in your issue of Aug. 10 you say, "Something more than the ordinary processes of law is required to guarantee punishment for building collapse."

The remedy is obvious: Let the engineers be licensed; then the buildings cannot possibly collapse.

West New Brighton, N. Y. FREDERIC W. JAMES.
Aug. 11.

Engineers and the Eighteenth Amendment

Sir—On page 172 of your issue of Aug. 3 in a reference to the eighteenth amendment, you say that engineers as such might reasonably have expected to have little interest in the eighteenth amendment and that to them the alcoholic content of a beverage would seem to be a matter of the slightest consequence.

A standard clause in construction contracts, especially in railway construction contracts, relates to the prohibition of alcoholic beverages on or about construction work. Intoxication is an inadmissible element in engineering design and in construction. No sane person would by choice or preference entrust engineering design or supervision to intoxicated engineers or execution of the work to intoxicated workmen. Engineers individually and as a class have or should have as much interest in the eighteenth amendment as any other person or class.

J. L. CAMPBELL,
El Paso, Tex. Chief Engineer, El Paso &
Aug. 11. Southwestern System.

Favor Lug Brick With Asphalt Filler

Sir—Readers of *Engineering News-Record* may be interested in having their attention directed to certain features in a paper by Prof. Arthur H. Blanchard entitled "Developments in Methods of Constructing Brick Pavements," presented before the Eighth Annual Michigan Conference on Highway Engineering held at Ann Arbor, and to discuss his conclusions as herein set forth. The paper describes the various phases in the history of development of brick pavement, beginning with brick laid upon sand foundation and sand filler, and concluding with the modern type of brick pavement which is brick laid upon Portland cement concrete foundation, sand bed and asphalt filler. It also recognizes the economic development resulting from the action of the Secretary of Commerce of the United States in calling a conference of the manufacturers and engineers regarding simplification of variety and standards for paving brick.

In the discussion of brick pavements only two important characteristics of an ideal pavement were considered, namely, imperviousness and durability. Part of the paper refers to the merit of various types of paving brick. This reference is based on the author's field studies of existing brick pavements and experiments under his direction with the co-operation of the director of the Michigan State Highway Laboratory and engineers of the Ohio Paving Brick Manufacturers' Association.

Professor Blanchard's conclusions and recommendations are as follows:

"Bituminous cements, possessing the desired characteristics, should be universally used for the filler."

"The use of plain wire-cut brick is accompanied with great risk relative to securing well filled joints. Conservative practice dictates that only lug brick should be employed."

The writer submitted Professor Blanchard's paper, together with a questionnaire, to about 400 municipal and highway engineers. The questionnaire sought the engineers' opinion regarding lug and lugless type of brick for asphalt filler. Of 103 engineers who answered the questionnaire 89 per cent favored the use of brick with lugs for asphalt filler. A tabulation, by states, of the opinions set forth in answers to the questionnaire is presented herewith:

State	Favorable to Lug Type	Favorable to Lugless Type	Indefinite or Uncertain	Total
Pennsylvania	12	3	1	16
Ohio	33	3		36
Indiana	13		2	15
Illinois	10			10
Missouri	5	1		6
Iowa	12	1		13
Kansas	7			7
Total	92	8	3	103

JAMES C. TRAVILLA,
Conneaut, Ohio, Consulting Engineer,
July 20, 1922. Dunn Wire-Cut Lug Brick Co.

Economics of Selecting Industrial Sites

Sir—In reference to Mr. Cresswell's letter in *Engineering News-Record*, June 8, 1922, p. 969, on "The High Cost of Tardy Engineering," there are other than purely construction costs which should be considered in determining the suitability of any site for an industrial or utility plant. These factors are not generally spoken of as engineering factors but as they are most certainly economic they come within the province of the engineer and should be called by him to the attention of the executive on whom rests the final decision, definitely, and in their proper relationship.

Freight transportation facilities are generally well studied out but those for passengers—meaning by this the facilities for handling the labor to and from the plant—are rarely given any attention. In the neighborhood of large cities especially, where there may be competition for labor, this is important. If the workmen have to spend an extra half hour, or pay an extra fare, twice a day dissatisfaction will soon develop, showing itself in an increased labor turnover. The resulting loss of efficiency possibly will more than offset the physical or commercial advantages.

Other phases of the labor problem may present themselves. If the social surroundings of the community do not meet the demands of the class of employees needed for the work, the result will be either an uneconomical turnover, or the substitution of a different class or race of workmen not naturally adapted to the particular industry. Native Americans, for example, require good schools and a fair chance of self-government and will not be satisfied to remain in a community of Poles or Italians whose standards of living, amusements and public welfare are so radically different. Where the number of operatives is small, relative to the surrounding population, such effect on turnover and operation may be great but will diminish as the number increases sufficient to form a community of its own.

Tax questions are important and should be put in their proper relation to the other factors. The writer has in mind a certain factory which was moved from a city of relatively high tax rate to an adjoining town with a lower rate, in order to save on this item. But the lower rate, though applied to a much larger area and showing a large saving in comparison with similar area in the city, was more than offset by unsatisfactory transportation facilities.

Care is required to make the proper adjustment of all the factors involved in a choice of location. Their relative values vary with different industries and with different cases in each industry. Thorough study must be made, therefore, to determine, first, the value that each factor should have *for that particular case*, and second, the value of that factor in each location under consideration. If, and when, this is done the final decision can be made on a basis of correct knowledge and the chances of mistake reduced to a minimum. L. J. CARMALT.

New Haven, Conn., June 29.

NEWS OF THE WEEK

New York, August 24, 1922

Cabinet Members Give Views on Hydraulic Laboratory

Secretaries of Interior and Commerce Favor Its Establishment—Weeks Opposes the Plan

Washington Correspondence

Establishment of a national hydraulic laboratory is favored strongly by the Secretary of the Interior and by the Secretary of Commerce, but the Secretary of War believes "in view of the necessity for economy in federal expenditures that this is not the time for establishing a laboratory."

The opinions of the three cabinet officers concerned most with hydraulic matters were sought by Senator Ransdell, the chairman of a sub-committee of the Senate Committee on Commerce, who will conduct hearings in the near future on a bill proposing the appropriation of $200,000 for the establishment of this laboratory.

Secretary Fall, in his reply, points out that the Interior Department for many years has recognized the necessity and the value of scientific research in river hydraulics.

In suggesting that the laboratory be conducted by the Geological Survey, Secretary Fall makes this point: "Not only is it necessary for the organization intrusted with this investigation to have had broad field experience, but it is equally essential that the fact-finding agency be separated from the executive agency. In this department, that relation between the Geological Survey, an investigative bureau, and the Reclamation Service, a construction service, has proved the practical and effective division of the work."

VIEWS OF HOOVER AND WEEKS

Secretary Hoover concurs in a report made by the Bureau of Standards on the bill, in which it is stated that "the waste due to floods makes this distinctly a national problem. Without question the solution of this tremendous waste problem rests on fundamental data concerning the flow of water, the wearing of structural and natural material, the transportation of material and water, and chemical and physical deposition."

Secretary Weeks says that he desires particularly "to emphasize that the hydraulic laboratory proposed would have no value whatever in solving flood-control and that the government would not be justified in incurring the expense of a laboratory for the investigation of flood problems," since "the reservoir control of the Mississippi flood problem is not practicable" and since "the art of dam construction is so far advanced in this country that a national hydraulic laboratory is not necessary to advance that science, and is certainly unnecessary to determine the proper design of levees. I may go so far as to say I would regard it as a misapplication of government funds to establish a laboratory for flood problem study."

To Hear Clay Products Rate Case

Freight rates on hollow building-tile and clay products from Brazil and related points in Indiana to Chicago will be the subject of a hearing at Chicago on Sept. 7 before Examiner Hillyer of the Interstate Commerce Commission.

Maps Prepared on Colorado River Irrigation Project

Maps for the Colorado River irrigation project which were completed by C. C. Holder of the Topographic Section, Geological Survey, have been received at Ballinger, Texas, for approval of the irrigation committee before further work on the project is launched. Mr. Holder spent nearly eight months making the survey, working under the direction of the government, and has been at Washington for the last four months making the maps of the proposed 200,000-acre district. Mr. Holder's preliminary report shows the project to be entirely feasible and the next move will be the creation of an irrigation district for the issuance of $10,000,000 worth of bonds.

San Francisco to Vote on School Building Bond Issue

The supervisors of the city and county of San Francisco will submit to the voters at a special election a $12,000,000 bond issue for the construction of thirty-five new school buildings and the acquisition of additional lands for school purposes. In addition, the supervisors are pledged to place a 15-cent tax in the yearly tax-rate to meet the needs of the school department for maintenance, repairs and upkeep of the existing school buildings and to construct three new schools each year to meet the normal needs due to the increase in the number of school children.

At the same election the voters will decide the issuance of $2,000,000 in bonds to finance construction of relief home buildings.

Bids Wanted Soon for Spavinaw Water Project, Tulsa, Okla.

Contractors wishing to bid on the new water supply for Tulsa, Okla., known as the Spavinaw project, are invited by the Water Commission of Tulsa to look over the ground. Final plans and specifications are about completed and bids will be received the latter part of September. The work includes a masonry and earth dam 50 ft. high; 28 miles of 60- and 25 miles of 54-in. pipe; 7,000 ft. of 78-in. tunnel; a 350-m.g. storage and a 10-m.g. high-pressure reservoir; and about 7 miles of cast-iron or steel force mains. Bonds to the amount of $6,800,000 for the work have been voted. The engineers are Trammel & Holway, Tulsa, and the consulting engineer is Dabney H. Maury of Chicago.

MacDonald Returns From Western Trip

Finds Pacific Coast States Have Attacked Highway Problems With Vigor and Effect

Washington Correspondence

Despite sparsity of population, difficult construction, long distances, and large proportions of land not now productive the Western states have attacked their highway problems vigorously and effectively, according to Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, who just has returned to Washington after an extended trip through the West. So that he might gain a better idea of the highway system that is being built up in the West, Mr. MacDonald covered 5,000 miles of the trip in motor cars. He is particularly impressed with the high standards of engineering being followed in the construction of western roads. This applies to the secondary as well as to the primary roads. He notes, however, that the states which have made most progress in the carrying out of their highway programs are those in which there has been stability in the personnel of the state highway commission and its staff.

Mr. MacDonald found very pronounced objection in the West to the limitation in the per mileage expenditure carried in the present highway law. In order to make the roads safe, where heavy grades and difficult constructuion must be undertaken, it is necessary to resort to higher standards of construction. The limitation in the bill discourages the more economical and the safest course. He also encountered a very general feeling that the rate of appropriation provided in the existing act does not allow for adequate progress in road building.

One observation which Mr. MacDonald made while on his trip, and which he thinks could be applied throughout the country in the interest of safety, is the practice of sanding asphalt surfaces on hills and at points where skidding of motor vehicles is likely to occur. This simple expedient, he found, practically obviated this danger and makes possible the safe use of mountain highways when the surface of the road is wet.

Texas Highway Association Holds Convention

Centralization of road-building activities under state control tending towards more efficient prosecution of a comprehensive campaign to bring Texas "out of the mud" was stressed during the recent convention of the Texas Highway Association, held in Galveston, Aug. 3 and 4. About 400 delegates from all over the state were present, representing business men, city and county governments, and state institutions.

Industrial Films Available to Engineering Societies

Engineering News-Record has from time to time received requests for information as to where moving picture films depicting various engineering and industrial processes may be secured free of cost. From various sources this journal has prepared a list which is deemed of sufficient interest to warrant publication. Though the films can be secured rent free, the cost of transporting them must be borne by the organization desiring them, and some guarantee must be given that the films will be returned in good order.

Following is the list and the information as to how they can be secured:

"Manufacture of Gas From The Coal Pile to the Meter," obtained through the American Gas Association, 128 East 15th Street, New York City; "Bombing Tests at Langley Field," Lieut. Geo. W. Haskins, McCook Field, Dayton, Ohio; "Combining Earth's Scattered Treasures to Produce Light," National Lamp Works, Nela Park, Cleveland, Ohio—attention of W. M. Johnson, Engineering Department; "The Story of Petroleum," Bureau of Mines, Washington, D. C.; "Processes Employed in Mining, Crushing, Handling and Transporting Trap Rock," Clarence A. Munson, New Haven Trap Rock Co., 67 Church St., New Haven, Conn. "Testing and Training for Mine Rescue Work," U. S. Bureau of Mines, Washington, D. C.; "Multiplying Man Power," J. Maxwell Carrer, care of Chas. A. Schieren Co., 30 Ferry Street, New York, N. Y.; "Hog Island Ship Yards," American Society of Mechanical Engineers, 29 W. 39th St., New York; "Coal is King," Diamond Power Specialty Co., Detroit, Mich.; "The Construction of a 60,000-hp. Hydro-Electric Plant," Stone & Webster, Boston, Mass.; "The Story of Ingot Iron," Bureau of Mines, Washington, D. C.; "Manufacture of Pipe," Charles Fitzgerald, White Oil Corp.; "Steam Railroad Electrification," S. T. Dodd, Railway & Traction Engineering Department, General Electric Co., Buffalo, N. Y.; "Production of Lead," John R. McGregor, Asst. Gen. Store Manager of the Eagle Pecher Lead Co., Bridgeport, Conn.; "Hydro Power Developments in Connecticut," A. J. Campbell, Connecticut Light & Power Co., Waterbury, Conn.; "Manufacture of Air Compressors, Drills and Coal Cutters," Sullivan Machinery Co., Chicago; "Manufacture of Genuine Wrought Iron Pipe," A. M. Byers Co., N. Y. C.; "The Cordage Industry," and "The Story of Sulphur," Bureau of Mines, Washington, D. C.; "A Dollar Saved Is a Dollar Earned," (pipe-covering industry), Bureau of Mines, Pittsburgh, Pa.; "Making Telephones in Tokio," Western Electric Co., New York; "Alpha Cement Manufacturing and Use," the Alpha Portland Cement Co., New York City; and "Soap Making," Kirkman & Sons, Brooklyn, N. Y.

In addition the following pictures are available through the General Electric Co., Schenectady, New York. The order should be given by film number.

Film 9, "Panama Canal"; Film 17, "The King of the Rails"; Film 23, "The Electric Giant"; Film 25, "The Island of Sugar"; Film 27, "The Queen of the Waves"; Film 28, "The Land of Cotton"; Film 29, "The Sugar Trail"; Film 30, "Big Deeds"; and Film 31, "Revelations by X-Ray."

Water Power to Be Subject of Am. Soc. C. E. Fall Meeting

The water-power problem will be the theme of the technical discussions at the fall meeting of the American Society of Civil Engineers, to be held Oct. 4-9 in San Francisco, according to a preliminary announcement from the office of the secretary.

For the first two days of the meeting members will get together largely to hear and discuss technical papers and to participate in local excursions. During the week-end of Oct. 6-9 there will be an excursion to the Don Pedro and Hetch Hetchy dams and the Yosemite Valley.

Special excursion rates will be in effect from the Atlantic Coast and Chicago. The round-trip railroad excursion rate without excess fare will be: From Boston, $147.66; New York, $138.32; Chicago, $86. The price of a lower berth in a Pullman for one way is: From Boston, $33.76; New York, $32.63, and Chicago $23.63.

The committee on local arrangements is composed of A. H. Markwart, chairman, and H. D. Dewell, Ely C. Hutchinson, Thomas H. Means, and F. H. Tibbets.

Paving and Street Railway Engineers to Confer

The Engineers' Club of Philadelphia, in co-operation with members of the American Society of Civil Engineers, the American Electric Railway Engineering Association, the American Society for Municipal Improvement, the Society of Municipal Engineers, the Federal Highway Council and the Motor Truck Association of America, has arranged an all-day conference, Oct. 9, for a general discussion on the design and construction of streets for street railway traffic. Announcement of the meeting is being sent to chief engineers of cities and of street railway companies throughout the country. Though the meeting is sponsored by a local organization, it is desired by that organization that the discussions take on a national aspect.

Inasmuch as the general subject is so important, it is considered best by the committee to limit the meeting to the consideration of the general subject alone and not take up other city paving questions.

As ramifications of the general subject will be taken up the location of utilities in the street, design of street-railway structures, paving and drainage of street for street-railway traffic, what the responsibilities of the railway company as to installation and maintenance paving costs should be, and the expense to which paving is affected by street railway tracks.

The committee in charge of the meeting is composed of the following men: C. M. Pinckney, New York City; Col. R. Keith Compton, consulting engineer, Baltimore Paving Commission; Major F. S. Besson, assistant to the engineer commissioner, Washington, D. C.; R. C. Cram, Brooklyn Rapid Transit Co., Brooklyn, N. Y.; E. J. McIlraith, Philadelphia Rapid Transit Co.; Julius Adler, deputy chief, Philadelphia Bureau of Highways; John Meigs, consulting engineer, Philadelphia; and Charles E. Billin, secretary, Engineers' Club of Philadelphia.

Preliminary Power Permit Held Not Binding

Attorney-General Holds it Establishes Priority Only—License May Impose New Conditions

Washington Correspondence

A formal opinion by Attorney-General Daugherty practically denudes the preliminary water-power permit, granted under the provisions of the Federal Water Power Bill, of its value. In his opinion conditions can be inserted in the license which were not indicated in the preliminary permit, and a license may be refused even though the permittee has complied with all the provisions laid down in the preliminary permit.

The Attorney-General's opinion is based upon the letter of the bill which prescribes that the sole purpose of the preliminary permit is to establish priority of application for a license. Any application for actual power development must therefore be considered on its merits and in the light of the conditions then existing.

Act May be Amended

Since large expenditures frequently are necessary to make the preliminary investigations, it is believed that this interpretation of the law will discourage expenditures for that purpose and lay a further obstacle in the path of water power development. It is very generally believed that this was not the intent of the law and steps will be taken at once, it is believed, to secure an amendment to the act which will make the preliminary permit sufficiently binding to justify applicants in incurring the expense necessary for the preliminary investigation.

The opinion is of particular importance at this time in that it relieves the Federal Power Commission from any obligation to issue a license on the Girand application covering a power site at Diamond Creek on the Colorado River.

Ontario Will Reserve Abitibi Power for Future Use

As a result of several recent conferences with the parties interested in power development in Northern Ontario, it is stated that the Ontario government has decided to reserve the Long Sault rapids on the Abitibi River representing 60,000 hp. of electric energy for future disposition. The Hollinger Consolidated has made application for the Three Carrying Places rapids where 40,000 hp. can be developed. The Timiskaming & Northern Ontario Ry. has waived its rights to any power for electrification on the Abitibi between Iroquois Falls and Tin Can Portage, and will develop a power on the Frederichouse River for the electrification of a portion of the line near Cochrane.

It is also understood that the T. & N. O. Ry. will seek further reservations of power between New Post, its present objective in the extension toward James Bay, and its final terminus at tide water. These reservations will provide two lots of 15,000 hp. each. Further conferences are being held to arrange for the control of the flow of the Abitibi River.

See No Gain for Public in Strike Settlement

Washington Looks Upon Cleveland Agreement as Truce—Expect All Operators to Sign

(Washington Correspondence)

A truce, with the contestants retaining their arms and preparing for a resumption of hostilities on a larger scale, describes the situation in the coal industry. It is an opinion in Washington almost unanimously held that all the operators eventually will accept the Cleveland agreement. So far as government officials are concerned, they will have little patience with any other course. Their position is that the public's need of coal is more important at this time than any issue involved in the strike. The viewpoint of government officials and members of the Congressional bodies is important not so much from any law the government can invoke as from the fact that they are assured complete publicity for their opinions on this subject and in that way can crystallize public opinion.

If the entire Central Competitive Field can get under way within ten days, it is believed that the situation can be tided over so that industry can be kept going. It is realized that the country's coal reserves are about gone. Widespread stoppage of industry will show itself soon unless capacity production is attained quickly. The ability of the country to produce coal is well known, therefore hoarding would soon cease. Such reserves as remain will be used up first with the knowledge that better prices are more likely to be obtained the longer purchases can be deferred.

The non-union fields are in a position to produce a record tonnage. Not only have many new mines been opened but it is predicted that all non-union operators will be paying the 1920 wage scale before Labor Day. All of this is on the assumption that normal transportation facilities will be available.

Results of Struggle

The result of the struggle is regarded as something of a draw. The strength of the union has been clearly demonstrated. The mine workers have successfully resisted a reduction in their pay. The check-off will continue and working conditions remain unchanged. The operators at least have broken up the Central Competitive Field. The prospects are that the union will lose some of the weakly-organized districts. No one of the fundamental ills of the coal industry has been remedied. Every issue involved in this strike must be fought out again. A truce has been declared but it is a make-shift.

The public is more concerned with the net effect of the strike. There has been a great industrial set-back. There has been widespread unemployment. The nation's fuel bill for 1922 will be $300,000,000 more than it was in 1921. One-half of one per cent of the population has taken advantage of its position to dominate the supply of a necessity. The interests of 99.5 per cent of the population have been affected adversely. There has been no humbling of the organization responsible. No industrial disciplining has resulted.

One of the big factors influencing operators to get back to work is the fear that they will lose markets permanently to the non-union districts which have a better coal. Reports to Washington indicate that many industries now that they have had a taste of high-grade coal, intend to use it permanently. Other companies fear the loss of business, gained at great cost, in the Northwest. They do not want to see Illinois get the business which represents a large outlay to them. There are other operators who think they can take in enough money in the next six months to make it attractive to take chances on the future. Some expect to sell all their coal for the high dollar as long as the market lasts and then go out of the business. Those with such ideas in mind will be interested in a recent statement by Fuel Distributor Spencer that agreements as to maximum prices will be sought immediately in those districts which return to work. He did say that it is possible that no control over prices would be attempted if the entire union area should resume operations. He called attention to the prompt flattening out of the market following the settlement of the 1920 strike.

There is some speculation as to the number of coal miners who may have gone into other industries during the strike. Some think they may stay with their new line of work and that there may not be such a superfluity of coal miners in the future. The majority opinion, however, seems to be that coal mining at the 1920 rate of pay is so attractive, when all other circumstances in connection with the work are considered, as to insure the return to the business of every man who has ever engaged in it and a considerable number of men from other industries where the wage scale is lower and where working conditions are more strict.

Grand Trunk President Resigns, Pending Reorganization

It is officially announced that Howard G. Kelley has resigned as a member of the board of directors of the Grand Trunk Ry. and so automatically ceases to be president of the road. His resignation has been in the hands of the government for some time in view of the impending reorganization, and its acceptance is stated to be due to the fact that his contract with the Grand Trunk expires Aug. 31. Pending the organization of the Canadian National Railways board the government has appointed Major Graham Bell, C. M. G., deputy minister of railways, to fill the vacancy on the board created by Mr. Kelley's resignation. W. D. Robb has been appointed vice-president and general manager.

League to Combat Oil Pollution of Coast Waters Formed

The National Coast Anti-Pollution League was formed at Atlantic City, N. J., as one of the results of a two-day conference of representatives of seaboard cities. Gifford Pinchot, state forester of Pennsylvania and gubernatorial candidate, was elected president, and Sedley H. Phinney, Trenton, N. J., secretary of the league.

The Engineer in Public Life

JOHN F. COLEMAN

Political work with the League for Good Government and service in connection with the Eye, Ear, Nose & Throat Hospital, a charitable institution, have been among the public activities of John F. Coleman, consulting engineer, of New Orleans. Mr. Coleman was born in 1866, is a founder and past-president of the Louisiana Engineering Society, and a past vice-president, American Society of Civil Engineers. His professional work has related largely to railroads and river and harbor improvements. Just before going into private practice he served as principal assistant city engineer of New Orleans, from 1896 to 1901.

He has been active in the work of the local Association of Commerce and also in the development of the port of New Orleans, having been sent abroad recently as representative for the Dock Board to investigate methods of operation of canals, inland waterways and port facilities in Europe from the business point of view.

Mr. Coleman's political activities have included the presidency of the Fair Election League and the vice-presidency of the Democratic Good Government League, in which capacity he had charge of a campaign for political betterment. As a member of the Board of Trustees for the Eye, Ear, Nose and Throat Hospital he has taken a prominent part in campaigns to raise funds for a new structure for this institution and is now chairman of its building committee. He is also a member of the New Orleans Association of Commerce.

Tariff Bill Permits Creation of Free-Port Zones

Washington Correspondence

Establishment of foreign trade zones at a number of American ports practically is assured by the action of the Senate Aug. 16 in adopting, with practically no opposition, an amendment to the tariff bill which would authorize the creation of such zones. The plan for the so-called free ports has been denounced by ultra-protectionists as a free-trade scheme. To meet some of the objections voiced against the proposal the Senate committee eliminated from the original amendment the authority to establish manufacturing enterprises within the free zone. It will be possible, however, to store, exhibit, break-up, repack, assemble, distribute, sort, refine, grade, clean, mix and otherwise manipulate foreign or domestic merchandise in an area where no compliance with the laws and regulations governing the entry of merchandise will be required. By making this possible it is thought substantial advantage will accrue to American shipping.

Safety Institute Has Extensive Accident Prevention Program

Preliminary plans have been made for a campaign of accident prevention to be carried out in October and thereafter under the auspices of the New York Public Safety Committee, of which Judge Elbert H. Gary is the chairman. The committee intends to extend the general program which has been followed during "Safety Week" throughout an entire year.

The committee invites general participation in this continuous program which is to contain three features. The first feature is safety teaching in the public and parochial schools. It has been shown that practically half of all that has been done to prevent public accidents can be done through the schools. The second feature is a school for automobile drivers which will be conducted in as many separate classes in the five boroughs of New York as may be required to serve the needs. In each class a course covering three months will be given and will be repeated at short intervals. The aims of this course will be to instruct drivers in the care and management of a car and also to develop a sympathy among drivers for the efforts of the police to control traffic.

Finally, an accident statistics bureau will be established as a department of the Safety Institute and its function will be to assemble and interpret the facts. Official approval of this project has been secured from commissioners of the departments concerned.

Proposes Regular Bus Service for New York Transit

Four plans whereby buses may be used to supplement the transit facilities of New York City were proposed by D. L. Turner, consulting engineer to the New York Transit Commission, speaking before the National Automobile Chamber of Commerce. The first of these is to provide a regular through-route service toward business in the morning and toward home at night for special groups of customers living in the same locality. The second is to provide crosstown routes on the streets having stations on the north and south rapid transit lines in order that the traffic may be distributed across town from such stations. The third is to handle some of the short-haul traffic in congested centers in place of the surface car lines now used. The fourth is to serve outlying districts at the ends of existing rapid transit lines.

Bus lines running between the termini of several rapid transit lines would hasten the settlement of regions that might otherwise remain undeveloped for a long time owing to lack of transit facilities. This in turn would tend to advance the date at which new rapid transit lines would be justified. Mr. Turner considered this fourth application as being the most important.

Ciani, not Cram

In the group photograph of engineer reserve officers at Camp Dix published on page 290 of the issue of Aug. 17, the name of Capt. A. J. Ciani was printed in error as Capt. A. J. Cram.

U. S. Roads Bureau Endeavors to Expedite Material Shipments

The Interstate Commerce Commission has been acquainted with all details of the situation with regard to the movement of road-building materials. Arrangements have been made for close co-operation with the Bureau of Public Roads and every effort will be made to expedite the movement of these materials. Even at best, however, it is admitted that there will not be enough open-top cars to go around from this time forward. Under the priority orders issued by the Interstate Commerce Commission, coal mines have the first call on open-top equipment. The volume of coal which it will be necessary to move in order to replenish the country's empty bins, is so great that the surplus of open-top cars will be small. So far as can be foreseen at the Bureau of Public Roads there is certain to be serious interference with highway construction.

Thomas H. MacDonald, Chief of the Bureau of Public Roads, calls attention to the fact that shortage of coal already has caused a reduction in the cement output with the result that a considerable number of projects already have been forced to suspend work.

The use of cement, he points out, is not confined to surfacing. Transportation officials frequently lose sight of the fact that it is essential for the bridges, culverts and the base for many types of roads. The public is penalized, Mr. MacDonald states, not only by the delay in using the road, but because contractors who suffer losses as a result of their inability to secure materials are inclined to bid higher on their next contract so as to make up those losses.

Notes on Wisconsin Highway Building and Operation

For the quarter ending June 30 A. R. Hirst, state highway engineer of Wisconsin, in his report to J. G. D. Mack, state engineer, states that 55 paving mixers were in operation and 65 will probably be in service before the end of the season. About 4 miles per day of concrete road were being built.

For experimental purpose 10 miles of paving will have a longitudinal joint. Obeservations indicate that 9-ft. pavements are free from longitudinal cracks. F. M. Balsley, chief inspector, has devised a machine for marking a dividing line separating travel in opposite directions.

The highway service map is distributed this year to 160 paid subscribers. Instead of the blue print used last year the map is printed in black on white paper with construction and detour information in red and green over prints which are corrected each week.

On the experimental wide gravel road maintained last year with a motor grader experiments with tar and calcium chloride are being made.

Signs 10 ft. wide and 12 ft. high showing a map of the state and the trunk highway system in the colors and conventions used in the official pocket highway map have been installed at all trunk highway entrances to the state.

German Firm to Resume Business Though Property Was Sold

A decision of importance and interest was handed down on July 26 by Judge Augustus N. Hand of the U. S. District Court for the Southern District of New York in a case involving the right of a German corporation to continue its business in the United States where its American property had been seized and sold by the Alien Property Custodian during the war. In the suit in question the purchaser of the American property and good will of Orenstein & Koppel A. G. of Berlin (formerly known as Orenstein—Arthur Koppel Co.), including its plant located at Koppel, near Pittsburgh, Pa., attempted by injunction to prevent the German corporation from again doing business.

In addition to its plant at Koppel, Pa., the Orenstein & Koppel A. G. had numerous plants in Germany and in other countries for the manufacture of industrial railway equipment, being among the largest concerns in the world of this kind. After the war, the German corporation opened an office in New York in the name of L. E. Hellmann at 50 Church St. Eric Joseph, who before the war was in charge of the entire American business, is now in charge of the New York office and was a defendant in the suit.

Judge Hand held that the sale by the Alien Property Custodian to the complainant of the American good will of the German corporation did not terminate or affect the right of the German corporation to do business in the United States in its own name and to solicit business among its former customers.

It was further held that the attempt of the complainant company to prevent the German corporation from doing business here in its own name, because the deed from the Alien Property Custodian of the tangible assets also purported to convey the good will of the corporation, was something which was neither covered in terms by the war legislation of Congress nor justified under any sound legal theory.

This is the first case decided by the courts involving the right of a German company, whose American property was sold by the Alien Property Custodian, to resume business in the United States.

Amarillo Considers Irrigation District Survey

The Board of City Development of Amarillo, Texas, has been asked to have a preliminary survey made of that portion of the Canadian River and its valley adjacent to the city for the purpose of determining the possibility and scope of a large irrigation project, including power and a water supply.

Civil Service Examination

UNITED STATES

For the civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local branch of the Civil Service Commission.

For vacancies in the Bureau of Standards: Junior engineer, junior physicist, and junior technologist, $1,200 to $1,500 per year. Examinations to be held Nov. 22.

War Material Distributed

The U. S. Bureau of Public Roads has reported that on July 1 there had been delivered to various states for use in road construction surplus war material valued at $139,773,986. The material, which consists of various supplies and equipment for which the department has no further need, has been distributed on the same basis as monetary federal aid. In value of material delivered, Texas and New York lead with nearly $8,000,000 worth; and all but five of the smallest states have received material valued at more than $1,000,000. The material includes 24,752 trucks and 4,573 automobiles.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.

The Kansas Section of the American Society of Civil Engineers has elected the following officers to replace two members who have left the section: Vice-president, Con M. Buck, division engineer, A. T. & S. F. Ry., Topeka, Kansas, replacing C. C. Williams; and secretary-treasurer, F. W. Epps, bridge engineer, State Highway Commission, Topeka, Kansas, replacing Frank Altman.

Personal Notes

EDGAR WINTON has been appointed county surveyor of Merced County, Calif., succeeding A. E. Cowell, resigned.

H. E. COLLINS, of Rogers, Brown & Co., pig-iron dealers, Boston, has severed his connection with the company, and will become associated with the Harry M. Hope Engineering Corp., consulting and designing engineers, Boston, on September 1.

A. J. STEPHENS for the past fourteen years manager of the Vallejo, Calif., plant and business operations of the Pacific Gas and Electric Co., has tendered his resignation, effective September 8.

WALTER MOORE, JR., formerly manager of the Southern California Chapter of the Associated General Contractors with headquarters at Los Angeles, resigned August 1 to accept the position of sales manager of the Union Rock Co., Los Angeles.

WALTER WARD, project manager, King Hill Project, U. S. Reclamation Service, has charge of the construction of the Black Canyon dam on the Payette River near Emmett Idaho. This work, involving an expenditure of $1,000,000, was recently started. It is the intention to finish the dam in time for use in 1924. Mr. Ward is succeeded at King Hill by A. M. Rawn, one of his assistant engineers.

EARL H. EBY, who has been a district engineer with the South Dakota Highway Commission stationed at Brookings, has been promoted to the position of construction engineer. His headquarters will be at Pierre.

T. S. SCOTT of Kingston, Ont., has been appointed city engineer of Niagara Falls, Ont., succeeding J. C. GARDNER. Mr. Scott was appointed out of a list of thirty applicants.

CHARLES F. FISHER, for the last two years and more engineer of City Planning Commission of Akron, Ohio, resigned that position effective Aug. 1 and is now at Providence, R. I., directing studies for the zoning of that city under Robert Whitten, of Cleveland, Ohio, who has been engaged by the city of Providence for the purpose indicated. Before going to Akron Mr. Fisher was street-extension engineer at Portland, Ore., and secretary of the Portland City Planning Commission.

F. H. SCHRADER, formerly resident engineer with the South Dakota Highway Commission, and stationed at Hot Springs, has been made a district engineer and will be stationed at Brookings.

J. B. MCREA, hydraulic engineer, Ottawa, has been appointed to conduct an investigation into the differences between the Ontario Hydro Electric Power Commission and the Dominion authorities, regarding the lease of power by the Commission at Romney Falls, Ont.

DON L. JACKSON, resident engineer for James Stewart & Co., Inc. of New York, for the past two years at Guthrie, Okla., has accepted the position of chief engineer for Eads & McCune, architects, of Chickasha, Okla.

R. W. KINNALLY, formerly resident engineer of the South Dakota Highway Commission, stationed at Huron, has resigned to become associated with the contracting firm of W. J. Cole at Huron.

J. M. PADGETT, until recently a foreman with the Weller Construction Co., road builders of Washington, D. C., has joined the staff of the Pottsville Construction Co., Grampian, Pa.

M. C. HINDERLIDER, consulting and supervising engineer, Denver, Colo., has been commissioned by the Greeley Poudre Irrigation District to make the necessary investigations for and prepare plans and estimates of cost for a high dam to be located on the Cache la Poudre river in Colorado. Mr. Hinderlider is a graduate of Purdue University. His first engineering experience was in Colorado in public land surveying. He was later engineer with the Board of Public Works of Denver, and from 1902 to 1908 engineer in charge of hydraulic work at the Rocky Mountain Division of the U. S. Reclamation Service. He was the engineer in charge of construction of the Hydro-electric Power Plant at Shoshone Falls, Idaho, and for the Central Colorado Power Co. in 1908 and 1909. Since 1909 he has been engaged in private practice.

JAMES C. BOYD, formerly connected with Westinghouse Church Kerr & Co. as first vice-president, has opened a consulting engineering office in Portland, Me., where he will specialize in railroad, power and general industrial development work. Mr. Boyd began his engineering experience in 1891, after three years at the Massachusetts Institute of Technology and survey work with the Bangor & Aroostook Railroad in Maine. Later, he was with the Boston Elevated Railway, first as assistant engineer and then as division engineer in charge of design, surveys and construction on the Charleston subway and part of the Atlantic Avenue Division. From 1901 to 1902 he was in charge of maintenance, structure, tracks and building of the Boston Elevated and the following year he was engineer in charge of new construction and of bridges and buildings of the Boston & Albany Railroad. For 18 years, Mr. Boyd was associated with Westinghouse Church Kerr & Co., New York City, and then resigned in 1920, to enter private practice. However, he became later associated with E. Corey & Co., of Portland, Me. He now announces that he is free again to act in a consulting capacity.

B. L. WARNER, formerly a resident engineer for the South Dakota Highway Commission, and stationed at Winner, has resigned and has accepted a similar position with the Illinois Highway Commission.

GEORGE Y. SKINNER and Associates, Inc., Civil Engineers and City Surveyors, with offices at New York City and Flushing, N. Y., announce a resumption in the general practice of civil engineering, surveying and real estate development, with additional facilities and personnel.

Obituary

JAMES KENNEDY, engineer, editor and author, died recently in New York City, aged 72 years. Mr. Kennedy was born in Scotland, receiving his primary education in Dundee, as well as learning the machinist trade there before coming to America in 1868. After his arrival here, he worked at locomotive construction and repairing on some of the principal American railroads, carrying on his studies at night. At one time, he had charge of a department in the locomotive shops of the New York Elevated Railroad. In 1883, he superintended the construction of the first steam locomotive built at that company's works. Mr. Kennedy became associate editor of *Railway and Locomotive Engineering* in 1905, and its managing editor five years later.

At the time of his death, he was editor of the publication and president of the Angus Sinclair Publishing Co. Several volumes of his poetry were published, among them being collected poems, songs and lyrical character sketches published in 1883; The Deeside Lass and Other Poems in 1888, and Scottish and American poems in 1899.

EARL POTTER MASON, production engineer and director of the Anti-Corrosion Engineering Corp., Inc., New York City, died recently at his home in Summit, N. J., aged 46 years. Mr. Mason was a graduate of the Massachusetts Institute of Technology. Previous to his connection with the Anti-Corrosion Company he was with the United States Shipping Board. During the war he was a commander in the navy and was in charge of all Shipping Board repairs. Previous to that position he had occupied executive positions with the Grinnell Company of Providence, R. I. He also engaged in the contracting business in that city for some time. He was a member of the A.S.M.E.

SAMUEL KINGSLEY PROBASCO, a son of Samuel R. Probasco, former chief engineer of New York City, and himself an engineering graduate of the University of Pennsylvania, died recently in New York City. Though an engineering graduate, Mr. Probasco studied law soon after his graduation and for the past twenty years he had been connected with the Brooklyn office of the New York City Corporation Counsel. Mr. Probasco was born in Burlington, N. J. and was 52 years old at the time of his death.

S. L. F. DEYO, former chief engineer of the Interborough Metropolitan Co., and of the Rapid Transit Subway Construction Co., New York City, and for several years both assistant engineer and division engineer of the New York, New Haven and Hartford R.R., died Aug. 18 at his summer home in Norfolk, Conn., aged 70 years. Mr. Deyo was a graduate of Union College. His engineering work in New York City was mainly in connection with the Park Avenue improvements of the New York Central R.R., and the construction of the first New York subway. He was also engaged for a time on the surveys and the construction of the South Pennsylvania R.R. He was, during his connection with the subway construction company chief engineer of the Interborough Rapid Transit Co. He was a member of the American Society of Civil Engineers of which he was a director in 1898-1900, and vice-president in 1904-1905. He was also a member of the Engineers' Club, New York City.

EDWIN CHAMBERLAIN, assistant engineer with the Philadelphia and Reading Ry. Co., died Aug. 15, aged 68 years. He was educated in the public schools of Philadelphia and prepared at the Lackawanna School, Scranton, Pa., for entrance to the Scientific Department of Lafayette College, Easton, Pa., entering the class of 1880. In the fall of 1880 he went to Reading, Pa., in the capacity of clerk to Edwin F. Smith, chief Engineer of P. & R. canals, waiting an opportunity to be placed in the engineering department. In 1881 he was made inspector of water powers. In January, 1882, he was transferred to the office of W. Lorenz, chief engineer of the P. & R. Co. and placed under direct charge of C. W. Buchholz, then assistant chief engineer. In March, 1883 he was made division road master at Reading and afterward division engineer and served in this capacity until 1886, when he was transferred to the Philadelphia Division, where he remained until January, 1887, when he was transferred to the chief engineer's office. After engaging in various work for six years he was elected city engineer of Reading, Pa., and served from 1894 to 1897. In 1897 and 1898 he was engaged in the enlargement and improvement of the water supply of the City of Binghamton, N. Y. He again entered railroad work in 1899. From 1906 to his death he was engaged on the elimination of grade crossings in Philadelphia.

BUSINESS NOTES

S. R. RUSIACKAS, until recently a student at Lafayette College, has been made an inspector of steel work with the Bethlehem Steel Bridge Corp., Harrisburg, Pa.

CARL J. LOFSTEDT has severed his connection with the Atlas Portland Cement Co., in Northhampton, Pa., by which company he was employed as a designer, and has joined the Palmer-Bee Mfg. Co., Detroit, Mich., manufacturer of conveying machinery.

THE HARDWARE MANUFACTURERS INSTITUTE has moved its offices from Memphis, Tenn., to Chicago. Its new address is 1026 S. Wabash Ave.

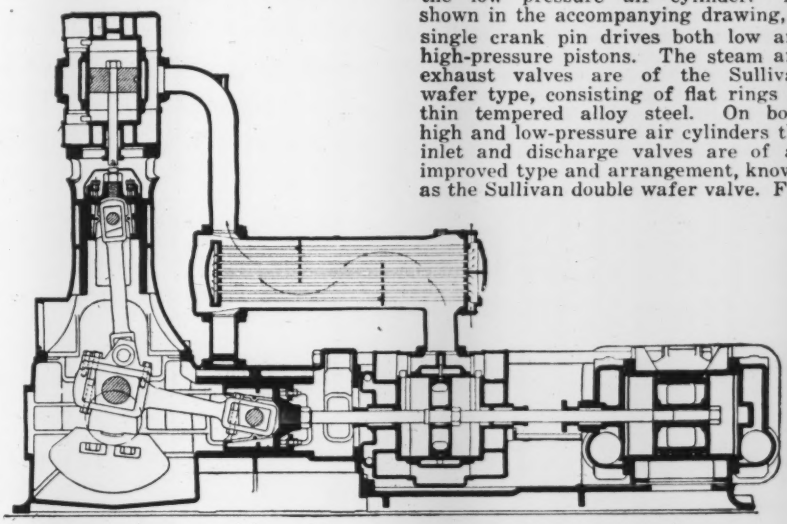
GEORGE E. TITCOMB, of the McMyler Interstate Co., New York City, has just returned from a five months' tour of Europe, inspecting port facilities and installations.

THE BUILDING MATERIAL EXHIBIT, Chicago, announces the establishment of a bureau of service which provides for engineers and architects conference rooms, a library of catalogues and specifications and service in making appointments for out-of-town architects and engineers with material men and others.

EQUIPMENT AND MATERIALS

Angle Compound Steam Driven Air Compressor

A new steam-driven, angle compound air compressor is announced by the Sullivan Machinery Co., Chicago. It consists of a two-stage compressor having its low-pressure cylinder in a horizontal plane and its high-pressure cylinder in a vertical plane. Power is furnished by a single high-duty steam cylinder in rear of and tandem with the low pressure air cylinder. As shown in the accompanying drawing, a single crank pin drives both low and high-pressure pistons. The steam and exhaust valves are of the Sullivan wafer type, consisting of flat rings of thin tempered alloy steel. On both high and low-pressure air cylinders the inlet and discharge valves are of an improved type and arrangement, known as the Sullivan double wafer valve. For removing the heat of compression in the air from the low-pressure cylinder an intercooler is provided, consisting of a cylindrical cast-iron shell containing a nest of copper or aluminum tubes through which cooling water circulates.



Heretofore, the company points out, its angle compound design of compressor has been belt-driven or direct-connected. The new compressor, however, is operated by a single four-valve direct-flow steam cylinder connected in tandem with the low-pressure or horizontal cylinder of the angle compound unit. The capacity range of the machine is from 1,000 to 3,500 cu.ft. of free air per minute.

Out-of-the-Ordinary Trade Publications

Centrifugal Pumps—THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., has issued a 16-page bulletin descriptive of the company's line of double-suction, single-stage centrifugal pumps. The pamphlet contains much useful engineering data.

Line Material for Mines—THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburgh, Pa., has issued a 64-page illustrated catalog devoted principally to equipment for overhead line construction in mines, including bracket arms, suspensions, insulators, trolley wire splicers. Information is given also on mine safety switches, strain insulators, solderless connectors, mine locomotives and headlights.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Prices Not Necessarily on the Toboggan

W. B. Bennett Calls Attention to Differences Between Conditions Today and After Former Wars.

William B. Bennett, consulting engineer, the United Railways of St. Louis, writes that statements as to what the "new normal" price level is to be are at best nothing more than speculative opinions. "Our theoretical economists," he says, "give us learned discussions as to what may be expected, based upon their interpretations of the teachings of the past, but all studiously refrain from making positive predictions for the future.

"I have given the subject of price trends considerable study during recent years in connection with the preparation and presentation of valuation estimates, but I have not settled in my own mind the extent to which the conditions existing subsequent to the War of 1812 (Napoleonic Wars) and the Civil War are present today; therefore, I am not willing to agree with those who take the position that prices have 'hit the toboggan slide.' I am mindful of the fact that the halt in the downward trend is not without precedent in the previous post-war periods. The history of prices in this country shows that subsequent to the rapid decline in prices immediately following the War of 1812 and the Rebellion, there was a temporary check in the price decline, lasting from two to three years, after which there was a recurrence of the rapid falling off to a pre-war level. But I feel that there are influences existent at this time which render conditions entirely dissimilar to those for periods with which many are wont to make comparison. Chief among these may be mentioned the gold supply and effective Governmental control of the monetary system.

"On the question as to whether or not there is to be a 'new normal' my opinion is that there will be. What this will be with respect to the pre-war level nobody knows. Some commodities, such as copper, apparently receded too far and now appear to be coming to rest at a level considerably above the low figure of a year ago. Certain other commodities, as for instance sand, gravel and crushed stone, continued to decline after the halt in the price drop of many other commodities, but these now seem to have come to rest. The trend of wages of labor has been steadily upward for over a hundred years and while we may perhaps expect some further reductions in wage rates these are not likely to go below the trend line as observed for the period prior to the World War and projected through the high price period to the present time. In other words, labor rates will not go back to the 1913 or pre-war level.

"The year 1913 still furnishes a good base level and should in my opinion be retained for some time. It permits of direct comparisons that will be most helpful in the presentation of valuation estimates to courts and commissions."

Finance Briefs

Stocks firm almost without exception and tending upward with new high records established. Dealings light, only 500,000 shares per day. The significant fact is that few of the higher grade stocks have been pressed for sale and that buyers had to bid sharply. At the same time, there can be no healthy market until the labor difficulties are settled.

Bond market inactive and unsettled; new offerings fewer than in any week in a year and a half. Municipals quiet because practically all bought up. Bankers urge new issues of public bonds, with little response.

Money plentiful. The business slowdown due to strikes has only increased the reservoir of money seeking use. Call funds, 3@4 per cent. Time loans, 4½ per cent for four months. *The Annalist* says, "Evidences are to be seen on many sides that the low point of the year has been reached."

Price Trend Is Upward

Warning that the "ups" of the market balanced the "downs" was first voiced by *Engineering News-Record* on May 11, p. 809. The situation was elaborated and interpreted in the light of the Cost and Volume Index Numbers in the June 8 issue, p. 976. All that was forecasted has practically come to pass. Construction cost is 4 per cent above the May figure. The Cost Index Number is now 173 against 164, on May 4.

Mills supplying the basic building materials have fallen off in production, due entirely to the fuel and car shortages. Dealers' stocks in the various distributing centers have been able thus far to meet the heavy demands. Before very long, however, the mill shortage may be reflected in a serious lowering of warehouse stocks. Even with the strikes settled amicably in the near future, it is probable that a sufficient number of cars cannot be put into service quickly enough to prevent slow mill shipments during the Fall and Winter months. Furthermore, the institution of a priority scale, until the car shortage is overcome, would give preference to materials other than construction.

With no perceptible let up in construction proposals and with danger of a material demand in excess of supply, further price rises may be looked for.

	New York		Chicago		San Francisco	
	May 4	Aug. 3	May 4	Aug. 3	May 4	Aug. 3
Steel shapes per 100 lb. (at warehouse)	2.58	2.83	2.48	2.68	3.10	3.10
Cement, f.o.b. without bags per bbl.	2.00	2.10	1.97	2.05	2.73	2.71
Lumber, 3 x 12 12 x 12, 20 ft. f.o.b. per M. ft. b.m.	43.00 (pine)	46@.47	40.00 (pine)	47.00	26.00 (fir)	31.00
Common brick, f.o.b. per M.	17.00	20.00	11.00	11.00	15.00	15.00
Lime, common lump, per bbl.	2.75@3.18 (280 lb. net)	2.75@3.14½ (280 lb. net)	1.40 (180 lb. net)	1.40 (180 lb. net)	1.75 (180 lb. net)	1.75 (180 lb. net)
Carpenters, per hr.	1.12½	1.12½	1.00	1.00	1.00	1.00
Common laborers, per hr.	.44@.60	.44@.60	.72½	.72½	.47½@.50	.47½@.50

Public Work Contracted For in 1921 and 1920

Less in 1921 than Municipal Bond Sales Indicated—Some Reasons

A correspondent asks why no more local public work was contracted for in 1921 than in 1920, when double the amount of municipal bonds were sold.

Statistics kept by *Engineering News-Record* do not classify buildings, and therefore it is impossible from these records to show the amount of public building placed under contract. It is possible, however, to give the value of road, bridge, sewer and water-works contracts. It must be understood that the following figures do not include water-works projects costing less than $15,000 nor bridge or road work under $25,000.

	1920	1921
Streets and roads	$265,423,000	$315,351,000
Bridges	35,214,000	27,331,000
Sewers	36,067,000	39,385,000
Water-works	30,772,000	40,603,000
	$367,476,000	$422,670,000

It would seem from these figures, therefore, that more public work was contracted for in 1921 than in 1920 unless public buildings fell off in 1921. It is quite likely that this was the fact, inasmuch as general commercial building did drop from $581,000,000 in 1920 to $568,000,000 in 1921, according to our figures.

Some of the facts of the case, therefore, are that more water-works, sewers, and road work were contracted for in 1921 than in 1920, this of course from a money standpoint. Costs in 1920 were at peak and nobody contracted for anything that could be postponed. High construction cost, however, did not dampen the avidity with which tax-exempt bonds were absorbed. It was a sunny year for municipalities in need of money and much hay was made. Contracts could be placed later when costs were more attractive.

Furthermore, of the $1,200,000,000 sales, $400,000,000 were made in the last quarter of 1921. This will also explain why the 1921 volume of contracts was not much larger than it was.

Our correspondent also offers some explanations of his own which are in line with the facts:

(1) The law customarily requires municipal bonds to be sold before contracts are executed. The plans may not be made until bonds are sold. Therefore, many months may elapse between the sale of bonds and the execution of of the contracts. Bonds sold in summer and fall of 1921 may not result in work during 1921.

(2) Bonds are sold in a lump for an undertaking which requires several years to complete. The proceeds lie on deposit until used.

(3) The result of the bond sales in 1921 may not be fully apparent until 1922.

(4) The percentage of state bonds for highway construction compared to city bonds may have been unusually large in 1921. The effect of state financing may not be felt until the subsequent open season, or during several open seasons.

(5) The percentage of public bonds sold for soldiers' bonus and non-productive purposes may have been unusually large in 1921.

Steel Wages Up 20 Per Cent

A 20 per cent increase in wages of common labor was announced by the U. S. Steel Corporation on Aug. 22 to take effect Sept. 1. The 150,000 men concerned will receive 35c. per hour. Judge Gary also stated that other rates would be equitably adjusted. A similar course will be followed by the independents. In 1915 the rate for common labor was $2 for a 10-hr. day; on Feb. 1, 1920, the wage was $5.06; now $3.60.

Lumber Movement Suddenly Expands

Following several weeks of decline the lumber movement revived surprisingly during the week ending Aug. 12, according to a summary of telegraphic returns from 379 mills reporting to the National Lumber Manufacturers' Association.

Recovering from the effects of forest fires during the last two months, the West Coast Lumbermens' Association increased production by about 13,000,000 ft. over the preceding week. At the same time car shortage, due to the strike, reduced shipments by about 16,000,000 ft. On the other hand the Southern Pine Association showed slight gains in production and shipments and an increase of about 14,000,000 ft. in orders. The net result was an increase for the whole country of 18,608,684 ft. in production, a drop of 11,691,542 ft. in shipments and a gain of 19,133,993 ft. in orders. The cut was 97 per cent of normal, orders 96, shipments 81. It is significant that shipments, taking the country as a whole, declined while orders and output gained appreciably. Demand and supply are in a prosperous balance, but delivery is difficult. Hence the rising market.

For the first time in the history of the American lumber industry the export trade of the Pacific Northwest exceeded that of the Southern pine region, during the first six months of the current year. In that period Washington, Oregon, and British Columbia shipped 624,367,409 ft. of lumber overseas as against 315,192,637 ft. of Southern pine; the fir movement having been 98 per cent greater than pitch pine exports.

Japan is the heaviest buyer of Pacific Northwestern lumber, with a gain of 319 per cent in purchases for the first half of this year, compared with the corresponding period in 1921. Total Japanese purchases were 381,019,667 ft. California water shipments increased 102½ per cent; total was 703,578,501 ft. as against 347,901,289.

Labor Cheaper on Federal-Aid Projects

Wage schedules, applying on thirty-nine different kinds of labor used in Federal Aid road work in June show a lower average hourly rate than the rates on all classes of construction as quoted monthly in *Engineering News-Record*. In the case of common labor, however, the Federal Aid (F.A.) rates in the various district are generally rather higher than the regular rates quoted in specific cities in those districts. For example, 38c. is given as the F. A. rate in New England, whereas 55c. was the official rate in Boston last June. The Middle Atlantic F. A. rate was 33c., compared with rates of 44@60c. in New York and 30c. in Baltimore. South Atlantic F. A. rate, 22c., against 20c. in Atlanta. West South Central rate, 27c., Dallas, 25c.; E. S. Central, 21c., New Orleans, 30c.; Mountain, 37c., Denver 35@50c.; Pacific, 46c., San Francisco and Seattle 47½ @60c.

JUNE FEDERAL AID LABOR REPORT—AVERAGE HOURLY PAY BY GEOGRAPHIC DIVISIONS

Kind of Labor	New England			Middle Atlantic			East North Central			West North Central			South Atlantic			East South Central			West South Central			Mountain			Pacific		
	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grace	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural	Grade	Pave	Structural
Foremen																											
Miscellaneous										.50													.52		.63	.75	
Superintendents	1.19	1.25	.75	1.08	1.05		.90	.92	.60	.93	1.03	.95	.82	.82		.81	.84	.79	.74	1.02	.84	.98	.99	1.00	1.11	1.23	
Foremen	.74	.75	.80	.68	.66	.68	.61	.67	.60	.63	.64	.61	.45	.55	.60	.51	.52	.53	.51	.60	.59	.69	.68	.79	.72	.88	.86
Subforemen	.63	.61	.69	.57	.55	.52	.50	.56	.61	.50	.50	.50	.36	.41	.37	.41	.42	.43	.43	.49	.31	.61	.58	.62	.67	.85	.66
Operators																											
Miscellaneous				.54	.53			.42		.52	.46						.42			.63		.62	.55	.52	.68	.56	.60
Auto drivers				.40	.42			.39	.35		.37	.30		.36	.19	.35	.31			.46			.50		.62	.73	.56
Truck drivers	.52	.51	.57	.43	.42	.43	.35	.42	.32	.36	.35	.38	.41	.37	.31	.30	.35	.43		.31	.32	.53	.51	.55	.65	.69	.67
Roller engineers	.68	.61		.54	.57		.52	.52		.52	.52		.44	.43	.54	.40	.41			.44		.60	.63		.79	.72	
Machine drillers	.30	.40		.45	.50					.65	.45			.37			.31		.45	.56		.53			.51	.62	
Mixer operators		.59			.64	.60		.55	.45		.60	.41	.60	.57	.30		.54	.32		.58		.62	.65	.45		.90	.75
Steam shovel operators	1.09	1.07		.85	.74		.73	.72		.76	.66		.80	.80		.78	.53	.50	.60	.99		1.00	.80		1.10	1.05	
Tractor operators	.45	.45		.41	.40		.43	.40	.45	.55	.48	.37	.33	.35		.28	.33	.30		.35		.62	.57		.75	.76	
Jackhammers	.35	.30		.57	.47		.30			.35	.42		.40	.30		.37	.28			.58		.59			.61	.55	
Crane operators					.71			.63	.75	.54	.65	.40	.50	.67			.52		.40	.60			.59		.75	.94	
Enginemen	.42	.55	.50	.50	.51		.51	.45		.57	.50	.41	.40	.60	.37	.28	.36	.45	.45	.47	.75	.75	.53	.47	.72	.67	.62
Skilled Labor																											
Miscellaneous				.55	.46	.50		.66	.50	.51	.51	.34	.25	.28	.25	.39	.26			.41	.65	.59	.45	.50	.56	.60	
Blacksmiths	.67	.67	.51	.57	.55		.45	.61		.50	.54		.44	.43		.39	.38		.41	.47	.30	.57	.56	.69	.65	.73	
Bridgemen			.85									.51						.50			.58			.40			
Carpenters	.80	.80	.70	.50	.59	.50		.70	.66	.45		.44		.37				.42		.46	.50	.50	.50	.76	.68	.66	.65
Bridge carpenters		1.15	1.02			.62			.54		.40	.48						.50	.50		.56	.75		.79			.71
Drillers	.57	.45		.45	.49		.50	.60		.60			.50	.34		.28	.25		.30	.30		.52	.46	.47	.53	.62	
Firemen	.67	.55	.35	.46	.43	.47	.62	.40	.25	.37	.36	.39	.41	.36	.23	.42	.30	.30		.35			.48	.40	.76	.72	
Finishers		.50	.57	.35	.46	.40		.51	.35	.30	.44			.25				.20		.32	.33		.68	.70	.68	.78	
Concrete finishers		.47			.48	.49		.41		.40	.52	.51		.32			.38	.33			.35		.49	.62		.85	
Masons	.55					1.12					.75	.60		.32				.78						1.00	.75		.75
Mechanics	.58	.60		.64	.61		.29	.42	.35	.54	.63	.60	.37	.32			.52			.84		.72	.53		.90	.83	
Powdermen		.39	.60	.63	.47					.52		.43		.35		.32	.33	.30	.30	.43		.65	.43		.58	.69	
Commissary Labor																											
Miscellaneous					.45					.30			.25	.20			.30				.10	.55	.24		.38	.58	.31
Cooks	.47	.37		.89	.70		.38	.38		.39	.48	.33	.30	.27		.23	.25	.24	.27	.22	.37	.48	.33	.32	.53	.53	.54
Assistant cooks	.33				.39			.30		.24	.33		.25	.18			.18	.15		.20		.32	.21		.39	.44	.40
Cooks' help		.35		.81	.37			.29		.26	.25		.20	.22		.10				.13		.50		.63		.34	
Flunkeys					.20					.23	.21	.30	.25	.12		.16	.08	.20	.20	.12		.37	.28	.31	.30	.29	
Waiters																						.40	.37		.25	.25	
Common Labor																											
Miscellaneous				.90	.90			.50		.42			.41										.52		.35	.43	.38
Common labor	.37	.38	.38	.33	.33	.33	.30	.30	.30	.28	.32	.30	.22	.20	.22	.21	.20	.21	.26	.24	.27	.40	.35	.37	.47	.50	.46
Teamsters	.38	.40	.42	.32	.60		.31	.29		.28	.26	.29	.16	.22		.20	.19	.20	.25	.21	.27	.39	.37	.37	.38	.48	.27
Teams																											
Teams	.50			.73	.60	.75	.37	.42	.25	.28	.24	.32	.36	.30		.27	.30	.25	.27	.29	.30	.31	.31	.28	.20	.43	.18
Teams incl. teamsters	.72		.82	.67	.70	.72	.55	.55	.58	.52	.49	.48	.50	.50	.62	.48	.41	.47	.48	.49	.47	.47	.51	.57	.60	.50	
2 Horse teams	.67									.44												.75					

Note—Rates in dollars and fractions of dollars.

Some Unit Prices on Contracts Awarded Last Week

Accepted bid prices on pipe, excavation and street contracts, awarded last week in various parts of the country and selected at random from *Construction News* are presented in the table.

Pipe bids cover cast-iron, reinforced-concrete and steel. Unit prices on earth excavation are taken from ditch, levee and State highway awards. Bituminous and waterbound macadam and vitrified brick blocks comprise the paving prices, while curbing bids are for both bluestone and concrete.

Pipe:	
8,000 ft., 20-in. rein.-con., at trench, East Orange, N. J., per ft	$3.20
8,000 ft., 6-in. c.i., Harlem, Mont., per ft	5.33
10,200 ft., Class C., 1,800 ft. Class D., 20-in., c.i. pipe, Birmingham, Ala., per ton	48.10
8,400 ft., 24-in. steel water-pipe, New Westminster, B. C., per ft	3.687
Earth Excavation:	
1,374,025 cu.yd., drainage, Boonville, Ind., per cu.yd	.09
92,263 cu.yd., ditch, Olivia, Minn., per cu.yd	.1
180,000 cu.yd., levee, New Orleans, La., per cu.yd	.25
65,000 cu.yd., levee, New Orleans, La., per cu.yd	.35
9,660 cu.yd., State Highway, Michigan, per cu.yd	.50
Rock Excavation:	
110 cu.yd., rock, Akron, Ohio, per cu.yd	3.50
Paving:	
12,300 sq.yd., 3-in., bituminous macadam, Akron, Ohio, per sq.yd	.93
12,300 sq.yd., 7-in., waterbound macadam foundation course, Akron, Ohio, per sq.yd	1.00
8,533 sq.yd., vitr. brick block paving, Winona, Minn., per sq.yd	1.99
Curbing:	
1,650 lin.ft. stone curb, Akron, Ohio, per lin.ft	1.25
17,700 lin.ft., 8-in., concrete curb, Akron, Ohio, per lin.ft	.20
28,350 lin.ft., concrete curb, Waukon, Ia., per lin.ft	.88

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	+$2.93	$3.65	+$4.20	+$2.92½	$2.95	$3.70	$3.10	$3.75	$3.75
Structural rivets, 100 lb	+3.85	4.35	+6.00	3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ¼ in. up, 100 lb	+2.83	3.50	3.50	+2.82½	2.85	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	60%	61.15%	45%	59½%	61.9–5%	+43%	46.6%	50%	30.00
Cast-iron pipe, 6 in. and over, ton	53.30	49.00	51.50	45.20	52.00	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.60	2.50	2.25	2.05	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	12.00	1.50	1.75	2.25	1.00	1.50
Sand, cu.yd	1.00	1.15	2.25	12.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	51.00@52.00	40.00	+40.00	47.00	40.00	50.00	31.00	23.00	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	−10.90	11.00	17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	+.1101	.086	+ 087	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	+.0808	....	+.087	.108	.11	.09
Linseed oil, raw, 5 bbl. lots, gal	.91	.97	+1.13	+.99	1.03	−1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.87 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Continued scarcity of coal and coke, resulting in increased production costs and further reduction in output, is forcing prices higher at the warehouses following each mill rise, however slight. Structural shapes quoted at New York warehouses at $2.93 as against $2.83; rivets at $3.85 advanced from $3.60, and reinforcing bars at $2.83 as compared with $2.73 per 100 lb., one week ago. Chicago warehouses quoting shapes at $2.92½ as against $2.80 and bars at $2.82½ as compared with $2.70 per 100 lb., last week. Mill price of structurals and reinforcing bars, $1.80@$2 per 100 lb., f.o.b. Pittsburgh. Bars quoted at $2, however, on small tonnages for quick deliveries. Wrought steel pipe discounts down 3 points in Denver warehouses following the general advance in pipe. Pittsburgh basing card of the leading interest, however, shows no changes as yet.

Fuel scarcity effecting hollow tile to the extent of slight price advances in both Chicago and Denver. Prices tending upward in New York. Brick, sewer pipe and other clay products retaining greater price stability than hollow tile in face of the fuel situation.

Raw linseed oil up 2c. in Chicago and 6c. in Dallas; down 6c. per gal. (5 bbl. lots) in Denver.